PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited.

41 PARK ROW (TIMES BUILDING), NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR $3.

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1892.		1893.	
December 3d	11,000	January 7th	12,250
" 10th	11,250	" 14th	12,250
" 17th	11,500	" 21st	12,250
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THE ELECTRICAL WORLD,

41 Park Row, New York,

OR ANY OF THE BRANCH OFFICES.

VOL. XXI. NEW YORK, FEB. 25, 1893. NO. 8.

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Editorial Discourtesy. WE are surprised to see that the editors of a contemporary publish matter from a correspondent, intended apparently to reflect upon the technical accuracy of THE ELECTRICAL WORLD, which they would surely have seen was incorrect if they had looked into it. We do not credit them with being unable to see the fallacies of their correspondent, but merely blame them for letting their feelings of antagonism toward a rival journal get the better of them. Such action does not reflect credit upon the editors of a technical journal.

Friendly Advice to Critics and Would-be Critics. OUR advice to critics and would-be critics who think they have found errors in something which somebody has published, is to think well before rushing into print, and if possible to, first consult a friend, and not a supposed friend; but above all let them remember the nursery story about the cat's paws, the chestnuts and the unscrupulous monkey. The columns of THE ELECTRICAL WORLD are always open for technical discussions, but not for venting personal feelings, especially against a contemporary.

Discussions of Technical Questions. READERS of a properly conducted technical journal who doubt the correctness of anything published in its columns will do better to communicate with the editors, who will, if the matter is of sufficient interest, always be glad to give impartial publicity to such criticisms, and if they have made any incorrect statement they will be only too glad to be set right. Critics will always obtain fair treatment from such journals. Never, to our knowledge has any one been refused publication in THE ELECTRICAL WORLD, for instance, of an article relating to anything published in its columns when supposed incorrect or doubtful technical statements were involved. In numerous cases in which critics had been too hasty, they were saved great embarrassment by discussing the point in question personally with the editors before rushing into print. Several cases have occurred, in which the authors afterwards withdrew their request, thanking us for having saved them from the embarrassment of defeat before the public. Had Mr. W. J. Jenks, who for some unknown reason, published criticisms in another journal of some statement made in THE ELECTRICAL WORLD communicated these criticisms to us instead, he would have saved himself the chagrin of being ridiculed before the public.

Proper Use of Terms. HAD there been any doubts in the minds of the electrical public of the timeliness of such remarks as we made editorially in our issue of Feb. 4 under the above caption, they certainly will have been removed by Mr. W. J. Jenks' communication in a recent issue of one of our contemporaries. That a person so long and favorably known to the electrical fraternity should allow himself to be made so ridiculous as he has by the stand he takes seems almost beyond comprehension. That he should couch his communication in such peppery language as he has seen fit to employ is a source of regret to us on his account alone, for a resort to such methods cannot injure the one against whom they are directed, but must return against its author with many times the virulence which was intended for its victim. As though such retribution were not sufficient, Mr. Jenks has been led into the embarrassing position of attempting to ridicule the A B C's of electrical science by showing his own total misconception of their meaning. The publication of his letter also involves the credit and dignity or honor of the editors of the paper in which it appears, for surely they cannot be accused of such total ignorance of the fundamental principles of the science in which they are enlisted as not to have known the position they were placing Mr. Jenks in, by giving his statements space. If aware of their character, the before-mentioned editors are guilty of dishonoring a friendship, and this, we take it, Mr. Jenks will find difficult to forgive, for a few words of explanation from them would have convinced him of his error, and he doubtless would have returned thanks for the kindly advice that had saved him from becoming the laughing stock of his confrères in business, who though younger in experience either know what they know, or know that they don't know, and therefore have the good sense to keep quiet. But we have no feelings of resentment against Mr. Jenks. We consider his position unfortunate, and deplore it rather than do we censure him. We believe that he has been used as a cat's-paw by the editors of a contemporary whose envy of THE ELECTRICAL WORLD has caused them again to cast discretion to the winds and to vent their spite against us even though it be at the expense of the dignity of a trusting friend and their own reputation. On another page we reprint the matter to which we refer.

The Lamp Decision. THE suspense in which the outside lamp manufacturers—in fact, the whole electrical industry—have been held pending the decision of Judge Colt in the recent case of the Edison Electric Light Company *v.* Beacon Vacuum Pump and Electrical Company *et al.* was brought to a close on Feb. 18 by the granting of the injunction prayed for by the plaintiffs. We have already given this case more space and have treated the subject more fully than has any other publication, and our readers who have felt sufficient interest in the case to follow our careful reports of the proceedings are already fully posted as to the nature of the evidence on both sides, and it only remained for us to announce to them, as we already have done, the conclusion reached by the court. For others it will be well to state that the plaintiff brought action for a restraining order against the Beacon Vacuum Pump and Electrical Company to prevent them from manufacturing and selling incandescent lamps alleged to be infringements of the patents granted to Thos. A. Edison on Jan. 27, 1880. The defense set up a claim of an anticipation of all that was essential in the Edison patents by one Heinrich Goebel, and this defense was so remarkable in many ways as to challenge the attention of the electrical world at large. Upon the credibility and validity of this defense depended interests of the greatest magnitude; and although the result of this trial was known not to be final, but merely to determine whether or not a temporary injunction would be allowed, it was felt by both sides that the outcome was of the utmost importance as giving a clue, at least, as to how a defense of this kind would be received at this late day by the higher courts of the land. It must be understood that the General Electric Company, who were the real plaintiffs, held an almost impregnable position as owners of the Edison patents, whose validity had been affirmed on July 23, 1891, and again by the Circuit Court of Appeals for the second circuit in October, 1892. In addition to this a preliminary injunction had been granted *pro forma* against the Sawyer-Man Electric Company in a similar suit, which was afterward affirmed by the Circuit Court of Appeals on Dec. 19, 1892. Preliminary injunctions have since been allowed against the Westinghouse Electric Company in Pennsylvania, the Perkins Electric Lamp Company and the Mather Electric Company in Connecticut. In these latter cases, practically no defense was made, and the fact that the Beacon company made any defense at all was a surprise to almost everybody, but its strength led many to think that its success was assured. But as we pointed out in our issue of Feb. 4, 1893, the rule is that where the validity of a patent has been sustained by prior adjudication, the only question open on motion for a preliminary injunction in a subsequent suit against another defendant is the question of infringement, the consideration of other defenses being postponed until final hearing, the only exception to this general rule being *where the new evidence is of such a conclusive character that if it had been introduced in the former case it would have led to a different conclusion.* The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him. This we pointed out in our issue of Feb. 4 and is the view taken by Judge Colt. In his opinion, which we print in full elsewhere, the Court finds that there is a doubt that the lamps 1, 2 and 3 were practical lamps. No. 4, while practical, in his opinion is suspicious and in his own words "envelops with a cloud of distrust the whole Goebel story," which otherwise he regards as improbable. With these doubts in mind, he gives judgment for the plaintiff.

The Effect of the Lamp Decision. THE decision in the lamp case, which under other circumstances would have attracted little if any attention, is considered by the General Electric Company a victory of no small importance, and as practically settling the line of defense relied upon. The outside manufacturers, however, while greatly disappointed, are not discouraged, and say that the fight has but just commenced. They claim that they did better than they dared to expect, and point to the fact that Judge Colt declined to enjoin the Beacon company without due consideration of their evidence as in itself a victory of which they may well feel proud. They claim that in the final hearings they will be able to present their case in much stronger light than was possible in the limited time in which they were compelled to prepare it in the case under discussion, and express themselves as confident of ultimate success. Final hearings in similar cases are set for Feb. 20 in Chicago, and Feb. 24 in St. Louis. What will be attempted by the defense in Chicago is not known at present writing, but a great fight will be made at St. Louis on the same line as that pursued in Boston, and it is claimed that new evidence will then be at hand that was not accessible heretofore. In the meantime, however, or until the final decision, the General Electric Company has the field to itself, and all lamp manufacturers not licensed by that company must close their works until the Edison patents expire. It appears that the General Electric Company now hold the reins absolutely and it remains to be seen how they will use the power which is legally theirs. With almost unlimited potency for good or ill, their actions will be jealously watched by the whole electrical fraternity. It is undeniably a fact that their past stewardship has alienated from them the sympathies of a very large number. To such an extent is this true that the acquisition by them of the Green electric railway patents, now admitted by them, is looked upon as foreboding no good to the electrical interests at large, for the reason that it is feared they will use these patents as they have the lamp patents in a way calculated to close the doors of competition and to further intrench themselves as a monopoly against which none may prevail. While the law is undoubtedly on their side, there are none who can afford to be so magnanimous as those who are most powerful, and their potentiality for good being equal to their potentiality for evil, it is to be hoped they will use it wisely.

Proper Use of Terms.

BY CARL HERING.

The discussion which was started by a recent editorial in The Electrical World shows that notwithstanding the fact that so much has been written about the distinction between the terms power and work, and notwithstanding the simplicity of the mathematical proofs, there still appear to be some persons who cannot understand the difference, while others who do understand it use the terms loosely. If greater care was taken in textbooks to use and explain these terms correctly, less confusion would result. The fact that there is still some confusion in the minds of perhaps no small number shows the importance of again bringing up this well thrashed discussion.

Work, being simply the product of force into distance, is of course independent of the element of time; it may be represented by the formula

$$\text{work} = \text{force} \times \text{distance}.$$

Power is work done in a limited time; that is, it is the rate of doing work, and therefore depends on the time in which the work is done; it is expressed by work divided by time, that is,

$$\text{Power} = \frac{\text{force} \times \text{distance}}{\text{time}} = \frac{\text{work}}{\text{time}}.$$

The essential difference between work and power, therefore, is that the former is independent of the element of time, while the latter includes the factor time as an essential element. The power of an engine, for instance, depends just as much on the time in which the foot-pounds of work are generated as it does on the foot-pounds themselves.

Simple as this may seem, however, it is nevertheless misunderstood by some persons. It is argued that a horse-power is a horse-power, whether it continues to act for a minute or a year, and that therefore the unit "horse-power" does not involve the element of time. The absurdity of such reasoning is best shown by an analogy. The speed of a railroad train is entirely independent of whether the train continues running at that speed for a minute, an hour, or a year; yet who would for a moment say that therefore speed does not involve the element of time! Power is precisely analogous to speed; it might even be defined as the speed of doing work. Speed and power are both the rates at which something is being done; speed is a distance divided by the time in which this distance has been traversed, and power is the work divided by the time in which that work has been accomplished. But both speed and power are, of course, independent of the length of time during which they continue to act.

The combination of a power with the time during which the power acts brings us to another set of convenient units, namely, the horse-power-hour, the watt-hour or kilowatt-hour. These are the products of a power and a time. We have seen that power is equal to work divided by time; therefore by multiplying power by time we obtain

$$\text{Power} \times \text{time} = \frac{\text{work}}{\text{time}} \times \text{time} = \text{work},$$

which proves mathematically that power-hour units are true measures of quantities of work and not necessarily of power. Such units, therefore, being a true measure of work, are independent of time, notwithstanding that the word "hours" occurs in their name. The same thing may be proved mathematically by means of the absolute system, in which the dimensions of power, that is, of watts, horse-powers, etc., is $m\,l^2\,t^{-3}$, which, if multiplied by time, equals $m\,l^2\,t^{-2}$, which is the dimension of work. Horse-power-hours and kilowatt-hours are therefore equivalents of units of work precisely as feet and metres are equivalents of units of length.

The expression 4 h. p., for instance, may, however, be used also to express something more than 7,920,000 foot-pounds. It may also mean 4 h. p. for 1 hour as distinguished from 1 h. p. for 4 hours or 2 h. p. for 2 hours. Whenever this distinction is meant, any careful writer will call special attention to it. However, whether this term has this additional meaning or not does not alter the fact that it is a true unit of work, even though it may embody in a loose way some additional qualification, which does not affect the dimension of the unit. If such a qualification is intended in the term horse-power, it certainly does not exist in the electrical terms watt-hours or kilowatt-hours. Five hundred watt-hours recorded in a meter certainly do not necessarily mean that 500 watts were used during a limited period of one hour or that 1 watt was used for 500 hours. It means that the integration or summing up of all the individual watt-hours amounted to 500; it may have been, and probably was, made up of large powers for a few hours and small powers for many hours. Moreover, 500 watt-hours are equivalent, without any qualification, to 1,127,200 foot-pounds, which does not include the element of time.

The British Board of Trade unit is the equivalent of a kilowatt-hour, but the question has arisen more than once whether it also means that 4 units, for instance, necessarily signifies 4 kilowatts for 1 hour instead of a summation of the products of various kilowatts and hours equal to 4. My own opinion is that it embodies no such qualifications, otherwise it would not be adapted for general meter registering; I have, however, no proof at hand at this moment, but it doubtless exists somewhere.

To speak of the coal consumption or the price of a horse-power is evidently a loose use of the term, unless accompanied by some such term as hour or year. It has, however, become the general custom to infer the term "hour" in the former, while in the latter the figures given will show beyond question whether they refer to the cost per hour or per year; such omissions in these particular cases is therefore quite excusable even though the statements are not exact.

Watt-hours (or horse-power-hours) are, like heat units, direct equivalents of foot-pounds, into which they are directly convertible without changing their dimensions. They differ only in that they are, for the sake of convenience, defined in different ways; the first is defined in terms of a power and the latter in terms of the heat required under certain conditions. It is like defining a volt in one case in terms of ampere and ohm, and in the other in terms of the lines of force cut per second. Perhaps some one will argue that it is mathematical jugglery to say that watt-hours and heat units are measurable in foot-pounds, and offer as an analogy that resistance might be measured as a velocity and induction as a length. But the case is different; no confusion or errors would be likely to arise from our not knowing that resistance and induction may be measured in time and length, but errors and confusion may easily, and do, arise by not remembering that watt-hours and horse-power-hours are measurable in units of work, just as errors may arise by confusing the terms power and work. At all events there is no harm in knowing it, even if one does not care to make use of it.

The Telephone Situation.—I.

The telephone is a subject of much discussion at the present time, in electrical circles more particularly, but also to a great extent among the general public. A great deal of speculation is going on as to the effect of the approaching termination of the monopoly of the right to manufacture electric speaking telephones which has been the means of building up the American Bell Telephone Company to the vastly rich and powerful concern that it is to-day. By many people the end of the Bell monopoly is looked forward to as a sort of panacea for a great number of evils like the hoped-for repeal of the McKinley tariff bill and of the Sherman silver bill, but to practical men the situation is clouded with doubt and mystery. Judging from the way some people, and especially some newspapers, talk, it would seem that there is a general expectation that directly the fundamental Bell patents expire, new exchange systems will, in all large towns and cities, spring up, Minerva-like, ready equipped with central offices, cables, wires, telephones, subscribers and all, ready to do business at a rate much lower than the existing charges for telephone service.

All sorts of wild rumors are going the rounds about new telephone companies, with enormously large capital, being organized to compete with the Bell companies, and telephones of all kinds, new and old, are making their appearance in all the States of the Union. The many inquiries that have lately been directed to The Electrical World show that the telephone situation, as it stands to-day, is not fully understood in all of its many bearings, and a detailed review of the telephone question in its various aspects will probably prove interesting reading to a large number of those who seek information in our columns. This we shall endeavor to give in this and subsequent articles.

The question of patents is naturally uppermost in discussion, although the expiration of the fundamental Bell patents will by no means have the powerful effect in breaking up the existing monopoly that it is generally expected to have. The patents that unquestionably will expire very shortly are the original Bell patent, which covers the method of transmitting speech electrically by undulatory currents, and the second Bell patent, covering magnetic telephones employing an iron diaphragm acted upon by a magnet and coil. The first expires early next month, the second in January of next year. It is claimed on good authority that the American Bell Telephone Company does not intend to institute suits against those who engage in the manufacture and sale of magnet telephones after the termination of the first patent, and various manufacturers are now turning their attention to this class of telephone, which, as is well known, can be made a very serviceable means of communication for reasonable distances.

With regard to transmitters the situation is not at all clear, and some very interesting developments are now preparing. Carbon telephone transmitters, employing a variable resistance of carbon in some form or other in connection with a battery and an induction coil, have been in use for the past fourteen years. A little over a year ago, in November, 1891, the famous Berliner patent, covering broadly the principles of the battery transmitter, was issued and this was followed a few months later, in May, 1892, by the almost equally famous Edison patent, which covers broadly the use of carbon in the variable resistance of battery transmitters. Since 1878 many different forms of telephone transmitters, all employing carbon variable resistances, have been patented in this country and abroad, and some of the English patents on such transmitters have already expired. Nevertheless, if the Berliner and Edison patents hold, practically all carbon transmitters come under their claims and the Bell company, owning both patents, still have strong patent protection against any encroachment on their monopoly of commercial telephony.

That these patents will be upheld for their full term and allowed to have such an effect is extremely dubious. The law has many surprises, however, and a thing that seems monstrous in equity may be very sound law. There is ample precedent for the granting of a broad patent many years after the filing of the application and long after the invention had come into very general use, and had been the cause of various subsidiary patents. Assuming that the Berliner and Edison patents are upheld the effect would be for one thing to give the Blake and other patents a life of nearly double the legal term, which would be an abuse of patent protection that could certainly be viewed with satisfaction by no disinterested parties.

According to an interpretation of patent law that has been upheld on various occasions, avoided on others, and never actually and decisively passed upon by the Supreme Court, the life of a patent in the United States is limited by the life of the foreign patent that expires soonest. This affords comfort to many who desire to see an end of the fundamental telephone patents, all of which have expired in England and should therefore have expired here. The Bell receiver patent expired in England more than two years ago, but the fundamental method patent was still in force here (and will be until March 4), and that covered the receiver, preventing any one in this country who might have been so inclined from taking advantage of the expiration of the British patent on the receiver and entering on the manufacture of magnet telephones. Those who hold that the death of a foreign patent also kills off the American patent, and have the courage of their convictions, can make and use or sell both transmitters and receivers after March 4, as the British patent on the Blake transmitter also expired last month. It is very doubtful, however, whether this clause of the patent laws is good law, and will be upheld by the Supreme Court when it eventually has to be passed on, which must occur some day. Other phases of the patent part of the telephone situation will be taken up in the next article.

A Choice Morsel.

The following choice morsel, which appeared in the columns of an alleged electrical contemporary last week, deserves a better fate than that to which it seemed doomed, and we have therefore rescued it from the oblivion to which it was consigned, and herewith give it place where it will see the light of day and be seen of electricians who alone can appreciate its sterling worth.

A CASE OF TEMPORARY ABERRATION.

Did the editor or publisher of "The Electrical World" manufacture his little list of first page paragraphs in the issue of Feb. 4 under the stress of an enlarged cranium too tightly incased in his ordinary hat? Hear him think aloud:

> **Proper Use of Terms.** We often notice, especially in papers written by mechanical, civil and other engineers who are not electricians, that they use electrical terms incorrectly. We refer at present more particular to the loose way in which the terms kilowatt and kilowatt-hour are used. A kilowatt is a unit of power or activity, and includes the element of time. On the other hand a kilowatt hour is a unit of work or energy, and is as a unit entirely independent of the element of time; it is precisely like the terms foot-pounds, or horse-power-hour, or joule into which it is directly convertible.

Could a man get mixed up much worse?

Can anybody conceive of how a volt-ampere, or any number of volt-amperes, can "include the element of time?" May not a watt be as truly a watt if expended only for 1-1,000,000 of a second as if such a rate of expenditure were kept up for a year?

Can the said editor, during the lucid intervals when his hat fits him, reflect that "a kilowatt-hour" is as a unit entirely independent of time, when time is one of its factors?

Is it really "precisely like the term foot-pounds," which does not include time (but which may mean a very rapid or a very slow expenditure of energy, according as it is coupled with a rate), and *also* precisely like the "horse-power-hour" which always indicates work done at a definite rate per second and also for a definite total period?

Let our friend, the editor, remember that every tyro in electrical study should understand that as long as volts represent difference of potential, and amperes represent simply and only the number of volts expended in each ohm of the resistance, the product of this total potential difference multiplied by this rate of potential expenditure for each ohm (not a rate as referring to time) will give the watts, which are still watts no matter how minute or how vast the period during which this degree of activity continues. Hence a watt or a kilowatt has nothing to do with time, and the "World" should be careful lest its honored editor places himself in the category of those whom he characterizes as "mechanical, civil and other engineers who are not electricians,"—who, by the way, sometimes do write papers which electricians do well to study with care. W. J. JENKS.

New York City, Feb. 9, 1893.

The question arises, How did it get where it was found? Was it through the ignorance of said alleged electrical contemporary? was it published to "get even" with Mr. Jenks for some past mortal insult to said editors? or did it happen through the absence of the office boy from his post? Our columns are open for the answer, which is important. In the mean time we are all attention.—Ed.

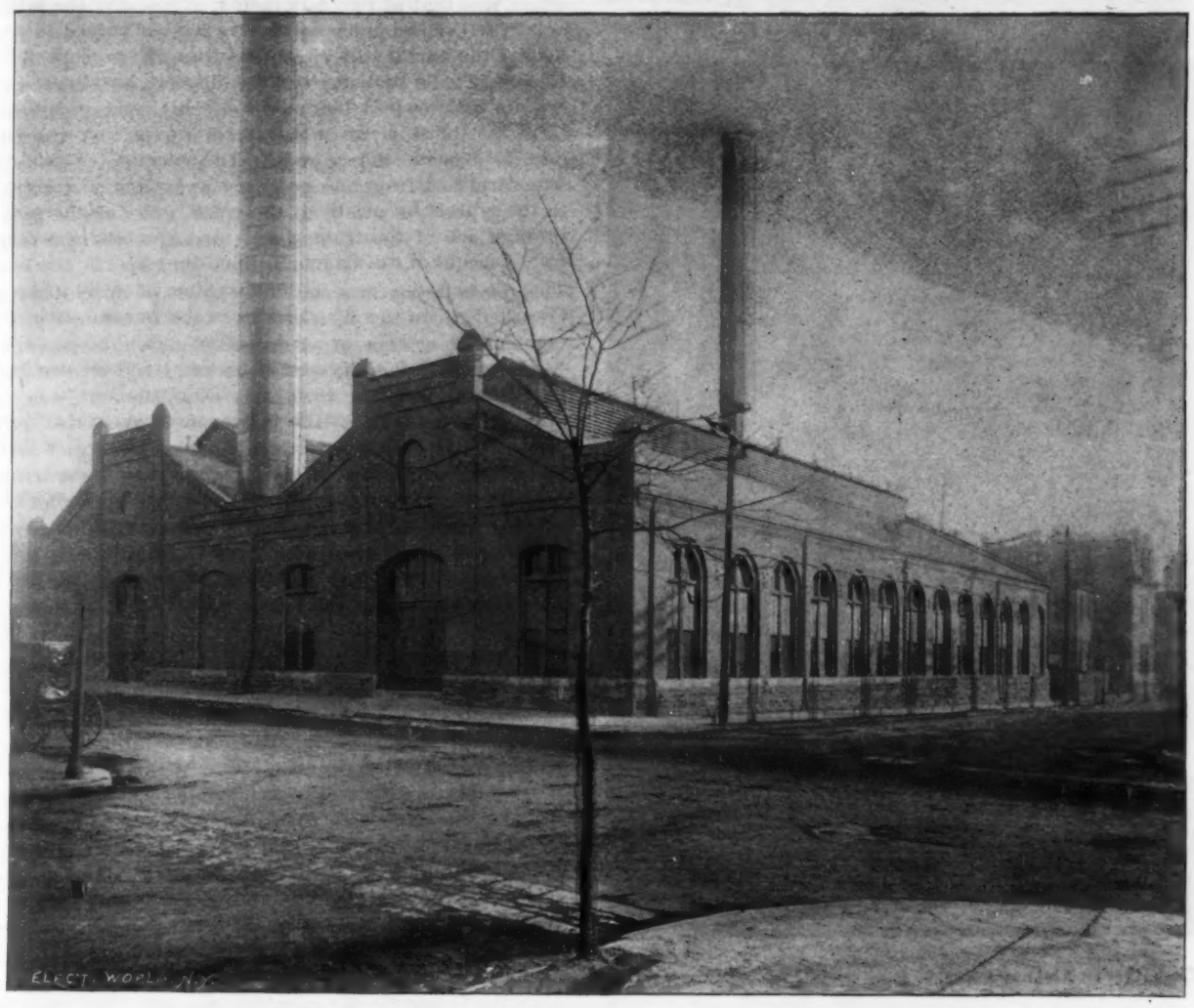
The Electrical Side of St. Louis.—III.

Turning now to the electric lighting interest, it may be well to make a brief review of the history concerning its rise. On Dec. 29, 1888, the City Assembly gave notice to the St. Louis Board of Improvements to advertise for 30 days in the newspapers of New York, St. Louis, Philadelphia and Pittsburgh for proposals to light the public buildings and city streets with electricity, and to prepare all necessary plans and specifications for the work. As but 10 days' notice was given to the Board, it was generally considered simply a political move, in which the people at large had so little faith that it is said that the day the contracts were awarded, March 9, 1889, a wager of $1,000 was offered that they would never be closed. Both the northern and southern districts of the city were taken under contract by Mr. Charles Sutter by the arc system, Washington avenue being considered the dividing line between the two districts. His bid for the southern district was $84,780.50, and for the northern $81,659.00, per year. One incandescent lighting contract for illuminating public buildings and alleys in the southern district went to the Missouri Electric Light and Power Company at $50,525 per year, and the other incandescent lighting contract for the northern district was awarded to Mr. Charles E. Brown, of the Western Electric Company, of Chicago, at $33,327.80. This latter contract was almost immediately turned over to the Laclede Gas Company, which, through its electrical department, continues to carry it out. The original specifications called for the following lights: For lighting the streets of the southern district, comprising the territory between Keokuk street and Washington avenue, 1,100 arc lights of 2,000 c. p. each; 20 2,000-c. p. lights for the parks; 30 arc lamps of the same power for lighting the public buildings, and, in addition, 200 incandescents of 30 c. p. each for parks and 2,200 incandescent 16-c. p. lamps for lighting public buildings; for the northern district 1,000 arc lamps of 2,000 c. p. each for street lighting; 10 arc lights of 2,000 c. p. each for the parks, and 50 of the same power for lighting public buildings; 100 incandescent 30-c. p. lamps for parks, and 890 16-c. p. lamps for lighting public buildings.

When it is stated that not one stroke of work had been done toward carrying the contract to completion when it was awarded, that there was practically nothing in hand to start with, and that but nine months remained in which to erect the stations, buy and install machinery, and string the circuits, the magnitude of the undertaking, and the popular feeling in regard to its probable outcome, will be readily understood. Mr. Sutter, who had received the contracts for the outdoor lighting for both the northern and southern districts, as his first move looked around for a competent superintendent, whom he found in Mr. James I. Ayer, and whom he appointed to that position on June 21. The successful result of this appointment—which we will endeavor to touch upon somewhat more fully later in this article—speaks volumes for the correctness of Mr. Sutter's judgment, and is a living monument to the energy and ability of the gentleman of his selection.

For the purpose of municipal lighting the city of St. Louis may be divided up into three districts, one known as the northern and southern district, another as the southern district, and a third as the northern district; to these may be added the Carondelet district at the extreme south. That known as the northern and southern district, which, from its title would seem to include the other two, comprises all the municipal arc lighting of the city. This is supplied by the Municipal Electric Light and Power Company, which is municipal only in name. The southern district is supplied almost wholly, as far as the city incandescent lights are concerned, by the Missouri Electric Light and Power Company, and the northern district by the Laclede Gas Light Company, which also includes an electrical department under the name of the Laclede Power Company. The generating station of this latter plant is located at the corner of Second and Mound streets, adjacent to the tracks of the Chicago, Burlington & Quincy Railroad. The building consists of a substantial brick structure 108×100 feet, and two stories high. The boiler room, which is immediately adjacent, covers an area of 41×100 feet. The engine power consists of two Williams triple expansion condensing tandem engines of 250 h. p. each, located at either end of a shaft, with which they are connected by means of Eclipse clutches. In addition to these there have been added two Armington & Sims cross compound engines of 250 h. p. each, which receive steam from three Heine safety boilers of about 300 h. p. each. The lighting circuits, which are all for alternating current, are supplied by Heisler and Brush alternators. Of the Heisler circuits there are six, none of which are less than twenty miles in length, and one reaching a length of twenty-eight miles.

The Brush circuits supply in the neighborhood of 6,000 16-c. p. lamps. In addition to these the Laclede Power company supplies some 600 h. p. for motors, nearly all of which are the C. & C. make, except those which are employed for elevators, which are of the Eickemeyer type. The increase of power sold by this company has been very rapid and marked, and has in some cases exceeded 100 h. p. per month. The Laclede Power Company has a five-year contract with the gas company to furnish power for its dynamos. The current for power purposes is supplied at 500 volts, and is sold at the rate of 1½ cents per horse power hour. One of the chief points of interest in this station is the rope transmission, which, we believe, is the only installation of the kind on an extensive scale in the city of St. Louis. Being located near the river, and not many feet above its surface, abundance of water for condensing purposes has been obtained by the sinking of a well, and the establishment is provided with one 500 h. p. Dean independent jet condenser and one 500 h. p. Dean surface condenser. We omitted to state that the power circuits are supplied by Brush direct current generators. This company has a contract with the city of St. Louis to supply 1,041 alley lights of 30 c. p. from sunset to sunrise at $17.50 per light, 356 first-class 16-c. p. lights at $20; 46 park lights of 30 c. p. for a half year, from sunset to midnight, at $3.75 per light.



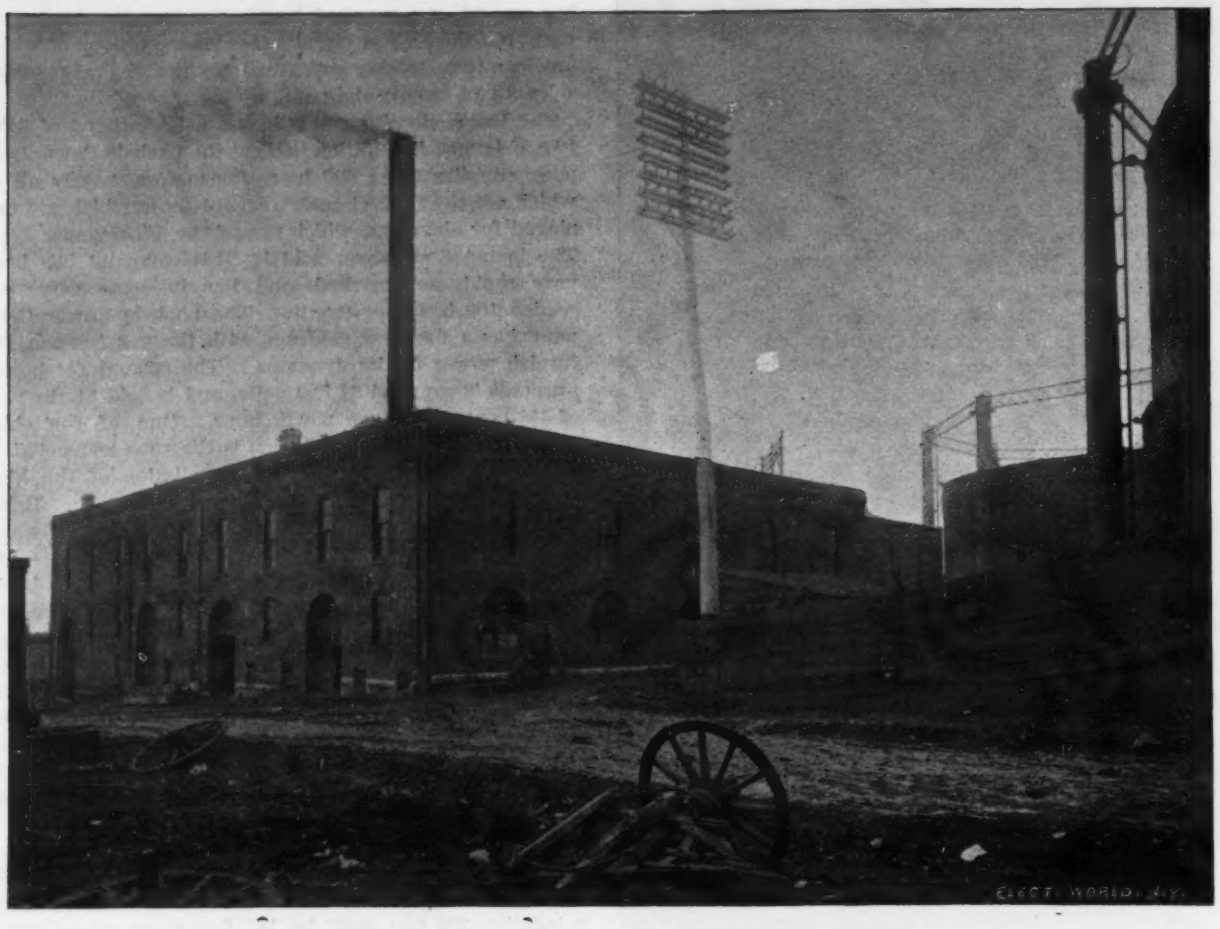
EXTERIOR MISSOURI ELECTRIC LIGHT AND POWER STATION.

THE MISSOURI ELECTRIC LIGHT AND POWER COMPANY.

The extensive plant of this company is located at the corner of Twentieth street and Lucas place, and occupies a building 269 feet front by 155 feet to an alley. This company was organized in January, 1889, and has a contract with the city for incandescent lights covering the southern district in alleys and public buildings. This plant, which does an exclusively incandescent business, is the only one in St. Louis devoting itself solely and specially to that branch of lighting. Having commenced operations on Jan. 1, 1890, its growth has been almost phenomenal, as at present it has 700 miles of street circuits, which supply 80,000 16-c. p. lamps, all of which, except those supplied to the city, are connected with meters. The plant consists of fourteen Babcock & Wilcox boilers of 250 h. p. each at 140 pounds pressure, three No. 16 Hooker pumps, four Berryman feed water heaters of 1,250 h. p. capacity, nine Westinghouse compound engines of 250 h. p. each, two Westinghouse compound engines of 500 h. p. each, two Westinghouse engines of 35 h. p. each, which are employed for running the exciter generators; nine Westinghouse No. 3 genera-

INTERIOR MISSOURI ELECTRIC LIGHT AND POWER STATION.

tors, each with a capacity of 4,000 16-c. p. lamps; two Westinghouse No. 4 generators, each with a capacity of 6,000 16-c. p. lamps. This plant is all arranged upon one floor, the boiler plant being separated from the generating plant by a brick wall. In the generating plant the engines, which are all of the Westinghouse make, are arranged down the centre of the building; and on either side, forming parallel rows, are located the various generators which are belted directly to the engine pulleys.



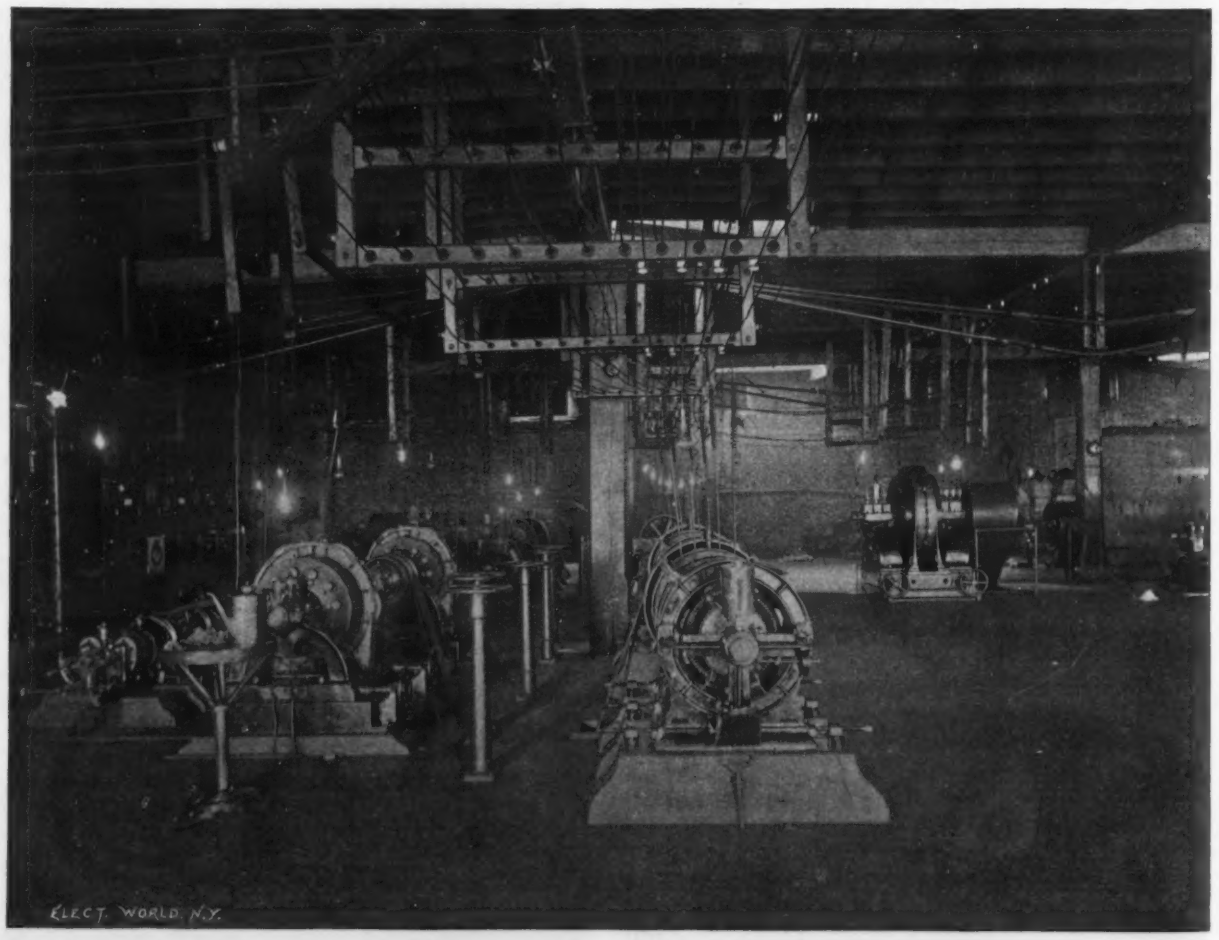
EXTERIOR LACLEDE ELECTRIC LIGHT AND POWER STATION.

At the farther end of this room is located the switchboard, which occupies the whole wall, and for completeness is probably the equal of anything of the kind heretofore constructed. The main exciter generators are two in number, having a capacity of 200 amperes at 100 volts; these supply the field for all except the two No. 3 generators, which are each supplied by a small exciter of 60 amperes capacity. These exciting generators are of the United States pattern. The current, as is usual in this country, is distributed at 1,000 volts, and transformed down by Westinghouse converters to 50 volts for lamp use. All of the lamp service is charged for by meter measurements, the Shallenberger alternating current meter being employed for this purpose. While the Missouri Electric Light and Power Company prides itself upon the fact that this enormous alternating current electric light station, now the largest one of its kind in the world, is purely a St. Louis enterprise, the Westinghouse Electric and Manufacturing Company also points to it with pride as being a typical Westinghouse plant—there being nothing connected with it of an electrical nature which is not of its manufacture. Its circuits, some of which are 50 miles in length, reach to all the representative places in St. Louis, including the leading hotels, restaurants, theatres, office buildings, clubs and churches, and the rapidity of the growth of its business speaks more loudly than words for the efficiency of its management, and the satisfaction which this service has given. While the title of the company would imply that this company was also supplying power, this is not yet a fact, as its business is confined solely to incandescent lighting. Of the 80,000 lights connected, 5,000 of these are furnished to the city, 25,000 to residences, and 50,000 are classed as commercial. The rate for service, which, as before stated, is entirely by meter, is, for commercial lighting, one cent per hour per 16-c. p. lamp; and for residences, 1¼ cents per 16-c. p. lamp hour. With the city this company has a contract to furnish 976 alley lights of 30 c. p. from sunset to sunrise, at $26; 28,088 first-class 16 c. p., at $9.50; 541 second-class 16 c. p., at $7, and 28 park lights of 30 c. p. for one-half year, from sunset to sunrise, at $30. We have stated that this company does no power business at present; this is not strictly true, for a number of very small motors for operating fans and for other similar purposes are supplied from its circuits. The converters employed range from those of 20-light capacity to those of 500 lights each, and the number of alternations employed is 1,600. Although it has been stated that in some of the circuits there are fifty miles of wire, the maximum distance to which current is carried from the station is but four miles. The total mileage of wire tributary to this station can be hardly less than 700 miles. The executive offices of the company are in the American Central Building, at the corner of Broadway and Locust streets, and the officers are: S. M. Dodd, president; J. C. Van Blarkcom, vice-president; S. B. Pike, secretary and treasurer; Herbert A. Wagner, general superintendent.

Visitors to the National Electric Light Convention will find this station one of the chief points of interest in the city. It may be conveniently reached by either the Washington avenue or the Olive street lines of railroad, and is but 10 or 15 minutes' ride from the Fourth street termini of these two roads. Mr. Herbert Wagner, the superintendent, under whose efficient management the vast business of this company has been built up, may be usually found at the lighting station, and we speak from experience when we say that he will be found willing and ready to extend all courtesies to electrical men who visit the magnificent plant over which he has supervision.

THE ST. LOUIS ELECTRIC LIGHT AND POWER COMPANY.

This is the company which, in a former article, was referred to as probably the first purely electric power station to be established anywhere in the world. Mr. Guernsey, its president, has many reminiscences to relate of the early trials and tribulations, not the least of which was a disastrious fire, through which his company passed in the early days. Commencing in 1886 with a 125-h. p. engine and two 40-h. p. generators, he has seen the business grow until now a capacity of 1,000 h. p. in engines and an equivalent in generators is required to supply the demands of their customers. In 1885, Mr. Guernsey states, he had built in Philadelphia a small electric car 2 feet long and 9 inches wide and 9 inches high. This he had painted in imitation of the Broadway (N. Y.) cars, and exhibited it at the St. Louis Exposition; for this purpose he had constructed an oval track 75 feet long, and placed along the longer diameter of the oval a series of mirrors, so that when the car was running in front of them the effect was that of two cars racing; at one end the mirror was placed at an angle so that as the car turned to pass behind the mirror the effect was that of two cars about to collide. So realistic was the illusion, he states, that crowds congregated before the display, and became so dense at times as to compel them to turn off the current to disperse the crowds. The current for this car was furnished from an arc light circuit, and was carried to the wheels by means of the track, entering the motor through one of the front wheels and reaching the other rail by means of the diagonally opposite wheel in the rear. This, he believes, was the first exhibit of an electrically propelled car in the West, and was the forerunner of the magnificent system of electrical cars which penetrate to all parts of the city and suburbs at the present day. On Friday, Dec. 20, 1889, this establishment was destroyed by fire and with it was destroyed this little electric car. As a matter of enterprise worthy of being placed on record, Mr. Guernsey states that he was first notified of the fire at 4.30 a. m.; at 5.30 a. m. he was seeking the loan of an engine to replace that destroyed by the fire. At 6 a. m. he was in consultation with Mr. Kennard, the president of the Exposition, in regard to obtaining the use of the steam plant at the Exposition to drive the dynamos which he had yet to obtain to furnish the current to supply his customers. In this he was successful. As soon as the first printing office was open he had circulars struck off notifying his customers of the total destruction of his plant, and stating that their motors would be again running on Monday. The boldness of this promise will be appreciated when it is known that his company was then supplying power to 65 factories, and that as yet he did not know where he would be able to obtain his dynamos. He next obtained some wire from the Lindell Railway Company, and by 9.30 of the same morning had a force of men at work. On Monday morning, as promised, all the motors were connected, but it was found that the circuits had insufficient capacity to supply the requisite current. By the addition of two new circuits the deficiency was supplied, and by Thursday (Wednesday being Christmas) all the motors were running, and have continued in operation ever since. The St. Louis Electric Light and Power Company has long since ceased to confine itself to a purely power business, but has for some time past furnished in addition current for arc lights. For power purposes Edison generators, furnishing current at 250 volts, are exclusively used by this company, and the arc lights are supplied from generators of the Western Electric Company's make. The motors supplied vary in size all the way from one-half h. p. to 25 h. p., and the power is furnished entirely by contract. At present the lighting capacity of the station is equal to 400 lights, and is added to from time to time as the demands increase. The station of this company is located at 210 Lucas avenue, while the business offices are on the first floor of the Laclede Building, corner of Fourth and Olive streets.



INTERIOR LACLEDE ELECTRIC LIGHT AND POWER STATION.

Shunt Motors.

BY W. D. WEAVER.

Many makers of dynamos and motors rate their machines at the same number of kilowatts, whether used as generators or motors, but it does not follow, of course, that the power at the pulley is the same in both cases with the same voltage at the binding posts. The amount of this difference for a given machine as well as several other practical problems in regard to shunt motors are given below, with reference to the data of an actual machine, as follows:

Voltage at dynamo, 110 = V.
Revolutions per minute, 800 = N.
Full load, ampères in exterior circuit, 60 = C_e.
Full load, ampères in armature = C_a.
Ampères in shunt, 2.75 = C
Resistance of armature, ohms, .1 = R .
" shunt, ohms 40. = R

Considering the machine first as a dynamo, the power delivered to the exterior or useful circuit is $C_e V = 60 \times 110 = 6{,}600$ watts. The energy supplied will be in excess of this by the watts required for the shunt, or $C_s V = 2.75 \times 110 = 302$; the watts required to overcome the armature resistance, or $(C_e + C_s)^2 R_a = C_a{}^2 R_a = (60 + 2.75)^2 \times .1 = 393$; and the watts required to overcome the air and load friction, eddy currents and hysteresis, which we will assume to be 630 in the present case. The total power required to be delivered to the pulley will be the sum of the above, or 6,600 + 302 + 393 + 630 = 7,925 watts, which will give a net or commercial efficiency of $\frac{6{,}600}{7{,}925}$ or 83.3 per cent., and an electrical efficiency of $\frac{6{,}600}{7{,}925 - 630} = 90.4$. The mechanical horse power required at the pulley will be $\frac{7{,}925}{746} = 10.6$, and the electrical horse power delivered to the useful circuit $= \frac{6{,}600}{746} = 8.8$. The useful torque at one foot from the axis of the shaft $= \frac{\text{foot pounds}}{2\pi \times \text{rev.}} = \frac{10.6 \times 550}{2\pi \times \frac{800}{60}} = 69.7$ pounds. The entire E. M. F. generated is the sum of that of the exterior circuit, and that lost in the armature, or $E = V + C_a R_a = 110 + (60 + 2.75) \times .1 = 116.275$ volts.

In considering the same machine as a motor fed from a 110 volt circuit, the armature reaction will be neglected and the losses through load and air resistances, hysteresis and eddy currents will be assumed to vary directly as the revolutions, in order to avoid complication. The manner in which the armature reaction would affect the result will be indicated later, and the magnitude will be less the greater the relative strength of the shunt field. The error in the assumption in regard to hysteresis, friction and eddy currents is probably too small to practically affect the results.

Assuming that the motor is so loaded that 62.75 ampères pass through the armature (its full load as a dynamo), the voltage lost in the armature through resistance is $C_a R_a = 62.75 \times .1 = 6.273$ volts, and in order that no more nor less than this current shall pass through, the armature acting as that of a dynamo will have to generate 110 — 6.275 = 103.725 volts of back E. M. F. The field being constant through the shunt always taking the same current, the revolutions to generate this back voltage are $\frac{103.725}{116.275} \times 800 = 713$, which is the speed of the motor under the given conditions. The energy supplied is $(C_a + C_s) V = (62.75 + 2.75) 110 = 7205$ watts Of this there are used in the shunt, $C_s V$ watts $= 2.75 \times 110 = 302$; in the armature, $C^2 R_a$ watts $= \overline{62.75}^2 \times .1 = 393$; and in the other losses $\frac{713}{800} \times 630 = 562$ watts, which leaves 7205 — (302 + 393 + 562) = 5946 watts for mechanical work. The net or commercial efficiency of the motor is $\frac{5946}{7205} = 82.5$ per cent., and the electrical efficiency $= \frac{7205 - (302 + 393)}{7205} = 90.4$ per cent. The net horse power is $\frac{5946}{746} = 7.97$ and the useful torque $= 7.97 \times 550$ divided by $\frac{713}{60} \times 2\pi = 58.7$ pounds.

From the above it will be seen that while the machine as a dynamo took 10.6 mechanical horse power with the full load armature current of 62.75 ampères, as a motor with the same current in the armature, the pulley horse power is only 7.97, a reduction of 25 per cent. It is also interesting to note that while in this case the electrical efficiency as a motor remains the same, the net efficiency is decreased.

To find the current required in the armature of the motor for any load at the pulley, let M = the given load and h the losses from friction, hysteresis and eddy currents; the value of h will be considered constant to avoid complication, which will introduce little error on account of the revolutions of a shunt motor varying little with varying loads, and the load friction varying inversely with the other losses. The entire energy supplied to the dynamo is $V(C + C_s)$ which must equal the expenditures, $M + h + C^2 R + V C_s$, from which equalities we find $C = \frac{V - \sqrt{V^2 - 4R(M + h)}}{2R}$.

For a load of 75 per cent. of the full load, the value of M is .75 × 5946 = 4459 watts; and substituting this and h = 562, V = 110 and R_a the above formula, we find C_a = 45.5. Proceeding as before, this gives 5.98 commercial horse power and 724 revolutions, with a commercial efficiency of 79.6 per cent., and a useful torque of 43.5 pounds. The various values for loads of 50 per cent., 25 per cent. and 10 per cent. have been similarly calculated, and are given in the accompanying tables.

It will be seen that for a given load the torque is fixed if the field remains constant. With the motor under consideration, the lowest number of revolutions is 713, as any less speed would permit too large a current to pass through the armature, and this corresponds to a torque of 58.7 pounds. These quantities are, then, the lowest limit of revolutions, and the highest of torque if the field is kept constant.

It will be interesting to examine into the effect of changing the strength of field, and we will take the case of the present motor at full load. Suppose the field circuit has a rheostat which will permit a greater or less current to enter the shunt, and further suppose the torque of the load to remain practically constant, which it will in many actual cases. As the torque is proportional only to the strength of the field and current in the armature, it follows that if the field is strengthened the current in the armature will be reduced, and *vice versa*.

If the field is strengthened 10 per cent. in the present case, the armature current will therefore be reduced in the same ratio or to 62.275 - 6.227 = 56.04 ampères, which will require $C_a \times R_a = 56.04 \times .1 = 5.604$ volts to force it through the armature, and a back E. M. F. of 110 - 5.604 = 104.29 volts to keep the current from exceeding the required strength. If this increase of the strength of the field were made with the machine as a dynamo at 800 revolutions, the total E.M. F. would be 116.270 + 10 per cent, or 127.9 volts, and consequently, the motor acting as a dynamo in generating a back E. M. F. of 104.29 has a speed of $\frac{104.29}{127.9} \times 800 = 652.6$ revolutions. As the torque is the same as before (58.7 pounds) the commercial horse power, varying only as the revolutions, $= \frac{652}{713} \times 7.97 = 7.15$.

The increase of current required in the shunt to bring the field up 10 per cent. in strength will depend on the state of the field cores in regard to saturation, and in the present case we will assume that the current will have to be increased 60 per cent., or to 2.75 + 1.65 = 4.4 ampères. The commercial efficiency will then be found 79.5 by the methods used above, and the electrical efficiency, 88 per cent.

If the field were weakened 10 per cent. the armature current would be increased in the same proportion, or to 68.5 ampères, requiring a back E. M. F. of 110 — 6.85 = 103.15 volts. Acting as a dynamo the machine at 800 revolutions would generate 116.275 — 11.6275 = 104.6475 volts, and the motor therefore in acting as a dynamo in generating 103.15 volts would have a speed of $\frac{103.15}{104.6475} \times 800 = 788$ revolutions. Proceeding as before, this gives a commercial horse power of 8.7 with a commercial efficiency of 84.3 per cent. and an electrical efficiency of 91.6 per cent., the current in the shunt being reduced 40 per cent. to decrease the field 10 per cent.

While there is thus a gain in both power and efficiency by weakening the field, the motor with a weak field would be undesirable on account of the sparking caused by the greater shifting of the resultant field with variations of current in the armature, and the greater variation of revolutions for a given variation of load.

Another interesting point remains, that of maximum efficiency. As the energy commercially utilized is $V C_a - h - C_a{}^2 R_a$ and the entire energy supplied is $V C_a + s$, where s = the shunt watts, the commercial efficiency is $\frac{V C_a - h - C_a{}^2 R_a}{V C_a + s}$ and, similarly, the electrical efficiency is $\frac{V C_a - C_a{}^2 R_a}{V C_a + s}$ These are maxima when C_a is

$$\sqrt{\frac{s + h}{R} + \left(\frac{s}{V}\right)^2} - \frac{s}{V} \quad \text{and} \quad \sqrt{\frac{s}{R} + \left(\frac{s}{V}\right)^2} - \frac{s}{V}$$

respectively. Substituting, these give values for C_a of 90.25 and 52 95 ampères respectively, so that the maximum of commercial efficiency entails a greater current and load than the armature can carry—quite a different result from the illustration in text books, where an infinitesimal current and load result from neglecting the losses. The efficiencies and other quantities resulting from these currents are given in the table.

	C_s.	C_a.	Rev.	Com. H. P.	Trq'e	Com. Eff.	Elec. Eff.
Dynamo, full load	2.75	62.75	800	10.6	69.7	83.3	90.4
Motor, " "	"	62·75	713	7.97	58.7	82.5	90.4
" ¾ "	"	48	724	5.98	43.5	79.6	89.6
" ½ "	"	33.2	731	3 98	28.6	74.9	89.1
" ¼ "	"	19	742	1.99	14.1	61.8	85.2
" ⅛ "	"	10.6	748	.796	5.58	39.9	77.8
Full load torque, field increased 10%	4.4	56.04	652	7.15	58.7	79.5	88.
Full load torque, field decreased 10%	1.65	68.5	788	8.7	58.7	84 3	91.6
Maximum commercial efficiency	2.75	90.25	694	11.4	86.6	83.6	89
Maximum electrical efficiency	2.75	52.95	720	6.68	48.7	81.3	90.5

The effect of armature reaction is to weaken the field by the amount of the resultant back field of the armature, so that in all of the above cases all of the quantities would be increased, and in a proportion greatest with the largest current.

The table shows what little value electrical efficiency has in a commercial sense. A machine might have a high electrical efficiency, yet a very low commercial efficiency if the losses from eddy currents and hysteresis were high.

The St. Louis Convention.

With this issue we are enabled to give for the first time the completed programme of the coming convention of the National Electric Light Association, to be held at St. Louis on Feb. 28, and March 1 and 2. No convention of the association has been held under more favorable auspices than that now under consideration, and it needs but a glance over the list of papers to be presented and their authors to satisfy one that they are in character entirely in keeping with the importance of the event of which they are to be a part.

When at Buffalo is was suggested that the meetings be held thereafter only at intervals of a year, the proposition was received at once with favor.

The simple fact that the St. Louis convention is the first to be held under the new regime, has given it somewhat unusual prominence, but there are other things that also contribute in that direction, not the least of which is the fact that it is the last to be held previous to the Exposition convention, and will therefore, in a sense, be preliminary to that most important event, when not only electric light men, but electricians of all kinds from all parts of the world, will be congregated at the city by the lake.

It is no reflection on the interest attaching to the other papers to say that the greatest centres around that to be read on Wednesday evening by Mr. Nikola Tesla, who has already set the world by the ears by his remarkable discoveries in electro-physics. With the laurels still fresh that were accorded him by the savants abroad, the equal of which have been accorded to no one before while living, he promises to open his mouth again, for the first time since he astonished our friends beyond the seas, before this convention. Surely this is an event which may well cause all eyes to turn toward St. Louis.

But this is not all. Prof. George Forbes, the celebrated English engineer, who arrived last week on the Majestic, will read a paper on Wednesday morning on Thermal Storage for Central Stations.

It is thought that many would like to take advantage of their proximity to Chicago to run up there to see the Fair Grounds, in which all are interested, and Mr. Baker, as though he had not already done all that could be asked or expected, has negotiations under way looking toward an arrangement for such a trip at reduced rates. These have not, however, been completed, and no positive announcement can be made at this date.

PROGRAMME ST. LOUIS CONVENTION.

Tuesday, Feb. 28, 1893.

Meeting of the Executive Committee at 9 A. M., parlor of Southern Hotel.

Morning Session, 10:30 o'clock, at Bell Telephone Building.

Address of Welcome, Hon. E. A. Noonan, Mayor of St. Louis.

Address, Pres. James I. Ayer.

Report, Committee of Data.

Afternoon Session, 2 o'clock.

Report, Committee on Safe Wiring.

Report, Committee on World's Columbian Fair.

Paper, A. D. Adams, Wrought vs. Cast Iron for Field Magnet Frames.

Wednesday, March 1.

Morning Session, 10 o'clock.

Paper, Prof. George Forbes, Thermal Storage for Central Stations.

Paper, Charles S. Bradley, Long Distance Transmission of Power.

Paper, L. B. Stillwell, Under What Conditions is the Use of Water Power Economical?

Afternoon Session, 2:30 o'clock.

Paper, E. A. Armstrong, Morals of Corporations.

Paper, R. H. Sterling, Some Experiences with the Alternating System.

Paper, William Brophy, Relation of Insurance to Electric Lighting and Power.

Evening Session, 8 o'clock.

Lecture, Nikola Tesla.

Thursday, March 2.

Morning Session, 10 o'clock.

Paper, W. H. Browne, Underground Conduits and Conductors.

Paper, Calvert Townley, The Incandescent Lamp from a Commercial Standpoint.

Paper, Dr. Louis Bell, Power Transmission for Central Stations.

Afternoon Session, 2:30 o'clock.

Paper, H. C. Myers, Preservation of Poles and Cross Arms.

Executive Session.

Reports, Secretary and Treasurer, Election of Officers.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

High Frequencies from Direct Currents.—Prof. Thomson's method called forth the following from London *Industries:*

"There is one method which, so far as we know, has not been tried yet. It was suggested by us before the Tesla experiments became fashionable as a convenient method of producing Hertz vibrations continuously and regularly. A direct current circuit has a resistance and an arc gap. In shunt to the arc gap is a circuit containing both capacity and self-induction in series, and the oscillatory current is produced in this circuit. The frequency varies inversely as the root of the product of the capacity and self-induction, and the main resistance can be adjusted to suit the circuit—that is to say, to make the current uniform from period to period, instead of having merely a succession of oscillatory discharges. Different currents of a given frequency can be produced by altering the capacity and self-induction without altering their product. The electromotive force is controlled by the length of the arc, but is, of course, greatest in shunt to the self-induction or to the capacity. Of course, this arrangement can be modified, but it seems to us to be much better than using a series of oscillatory discharges at short intervals, as is now customary with alternating transformers."

Before the French Academy of Sciences Mr. Vaschy demonstrated the following theorem: In one or a number of networks of conductors, which may even contain condensers in the branches, if an electromotive force $E = f(t)$ placed in one branch A produce a current of intensity $i = \varphi(t)$ in a branch B (be it in the same network as A or in one of the other networks), then reciprocally the electromotive force E placed in B and varying according to the same law f (t) will produce in the branch A a current i varying according to the same law φ (t). The theorem applies also to networks having no metallic connection, but having reciprocal electromagnetic induction. An abstract of his paper will be found in "La Lum. Elec.," Jan. 28, p. 189.

Mr. Wesendonck, regarding electrification produced by friction of air, describes some experiments made by himself (Weidemann Ann., Vol. 47, 1892, No. 12), in which he finds that air containing dust and moisture may obtain quite a charge by friction against metal, but by careful filtration and drying this can be reduced as far as one desires; he finds that pure air produces little or no electrification. Oxygen behaves like air in a pure state. Liquid carbonic acid gas will charge the metal positively, but as a gas it produces no electrification.

In experimenting with the Hertzien phenomena Mr. Birkeland uses the telephone as a spark meter. For a short description see "Elek. Zeitschrift," Jan. 24, page 43.

Boron.—Mr. Moissau, according to the Lond. "Elec. Rev.," investigated the properties of pure amorphous boron, obtained by reducing boric anhydride by metallic magnesium. He finds that boron is not fused in the electric arc, but when heated for a long time at 1,500° C. it shows signs of agglomeration. Its specific resistance is 801 megohms. In its chemical relations it is remarkably analogous to carbon.

In a long article by Mr. Boucherot, in "La Lum. Elec.," Jan. 28, he makes some theoretical deductions concerning the relative cost of condensers in connection with the question of whether it would be cheaper to introduce a condenser directly in a circuit or to introduce it in the secondary circuit of a transformer. It is known that the effect will be the same if a condenser be introduced directly in the circuit or if instead of that a transformer is inserted with a condenser in its secondary circuit. The discussion is a purely mathematical one, but as such it is interesting, and although condensers are not yet used to any extent, the paper is of interest in so far as it calls attention to the various points which arise, and shows the conditions which are probably the most economical. Meaning by a "farad-volt" a condenser of one farad capable of standing one volt, he concludes that a farad-volt at high tension must cost one-fourth to one-fifth of a farad-volt at low tension in order that a condenser with a transformer be more economical than a condenser directly connected in the circuit; the cost of the transformer being included.

Polarization in Electrolysis.—A long discussion has been carried on in the "Ann. der Physik und Chemie" (Vol. 38, p. 362; Vol. 39, p. 187; Vol. 39, p. 201; Vol. 45, pp. 759, 797; Vol. 45, pp. 475, 507), regarding the much discussed question of polarization and resistance in electrolytic decomposition. Those interested are referred to the original papers. Some deductions from the latter paper are given in the Lond. "Elec. Rev.," Feb. 3. An interesting phenomenon in the latter paper is that of "current reversals;" in this phenomenon the anode may become incandescent, sometimes splitting and being completely disintegrated.

Mr. Bottomley read a paper before the Royal Society on thermo-radiation in absolute measure, a short abstract of which is contained in the Lond. "Elec. Rev.," Feb. 3. The portion which interests electricians is the radiation of heat from the surface of wires which may be deduced from figures which he gives.

MAGNETISM.

Mr. Markham, in the Lond. "Elec. Eng.," gives the following information regarding malleable cast iron. The samples tested were three in number, in the form of bars 18 inches long and 2 inches in diameter. They were cut as shown by dotted line in Fig. 1, and then turned down to round pieces, one from near the outside and one from the inside, as shown at B and C, respectively. These rods were tested in a Hopkinson yoke with a ballistic galvanometer and the method of reversals. The

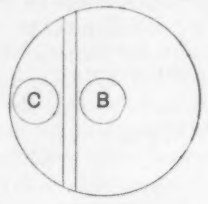


Fig. 1.

results obtained are shown in curves B and C respectively in Fig. 2. The individual curves varied only a very little from the average curves here given. Curve A is for wrought iron and curve D for cast iron, which are given here for reference.

Measurement of Magnetic Properties of Iron.—In a paper read by Mr. Gray on this subject before the Royal Society, he gives a method of experimenting and the results obtained, of the time-ratio of rise of current in a circuit having large electro-magnetic inertia. A large electro-magnet was used with laminated cores and pole pieces. The main length of the iron circuit was about 250 centimetres, and its cross section 320 square centimetres; the magnetic coil had 3,840 turns, and a resistance of 10.4 ohms; the coils could be joined up in a variety of ways, so as to vary the resistance, the inductive coefficient, etc.; the magnet could also be used as an open or closed circuit transformer; the current was obtained from storage batteries; in the experiments a curve was drawn on a chronograph, giving the relation of current to time.

He showed the effect of varying the impressed E. M. F. on the time required for the current to attain any given percentage of its maximum strength. The results show that for any particular percentage there is also a particular E. M. F. which takes maximum time; it takes longer time, for instance, for the current produced by four volts to reach 95 per cent. of its maximum than it takes for the currents produced by either three or five volts to

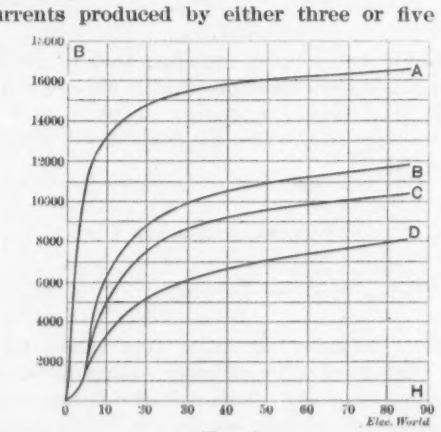


Fig. 2.

reach 95 per cent. of their maximum. Within considerable limits the time required for the current to become uniform is nearly universally proportional to the impressed E. M. F.; for moderate E. M. Fs. the time may be very great; for two volts, for instance, the current, being suddenly reversed, required over three minutes to establish itself; the time for reversing previous magnetization was very marked when the iron circuit was closed. He shows that great errors may arise by using the ballistic methods specially for weak currents. For measuring resistances containing electromagnets, time may be saved by using high E. M. Fs. On stopping the current, when the magnetic circuit is closed, several minutes may be required for the magnet to lose its magnetization by dissipation of energy in the magnetizing coil. A comparatively small air space nearly eliminates the residual magnetism, and diminishes considerably the rate of variation of the coefficiency of induction and the dissipation of energy in the magnet. When used as a transformer, he shows that less energy is dissipated in the iron the greater the load on the transformer. He shows that the energy of hysteresis is simply proportional to the total induction; he cites the experiments of others which confirm this view.

MEASUREMENTS AND INSTRUMENTS.

The Lond. "Elec. Rev." describes the following improvement of the Siemens electric pyrometer, in which a coil of platinum is wound on a clay cylinder packed in an iron tube. Mr. Callender found that after it had been used up to a temperature of 1,600 degrees F. its resistance had increased about 15 per cent., corresponding to an error of 100 degrees F. As he attributes this to the clay, he now uses mica, which has no action on the wire. He also uses a tube of glass or porcelain instead of iron, and fuses instead of solders the connections; he uses a bridge method instead of differential galvanometers.

"L'Electricien," Jan. 28, gives a short illustrated description of a galvanometer for lecture purposes, made on the principle of the Wiedemann instruments; also, of an electro-dynamometer for lecture purposes, intended to replace the well known apparatus usually used to explain what are known as the Amperian reactions, that is, the direction and intensity of the force acting between two currents.

Condensers.—Mr. Boucherot states that above certain voltages, depending on the material used, the cost of a condenser can be said to be proportional to the capacity and to the square of the voltage which it is to stand; the price is independent of the frequency. The loss in an ordinary condenser at full charge, he states, is at most one per cent.

DYNAMOS, MOTORS AND TRANSFORMERS.

The English journals contain a description by Mr. Brown of a new non-synchronous motor for ordinary alternate currents. It possesses the characteristics which until now were obtainable only by multiphase-current motors, among which are the absence of collectors and brushes, the consequent simplification of design and reduction in the attendance, the possibility of starting against a load, and non-synchronous running with its attending advantages. The absence of the collector is of the greatest importance. He claims that the disadvantage of triphase currents is the complication arising from using three mains. (This objection, however, does not appear to us to be a very great one, as three wires are used in the three-wire distribution system in most of the large central stations.) He claims that the unfavorable results heretofore obtained with alternate current motors are due to the want of attention to the magnetic resistance of the air gap; owing to the abnormal magnetizing current required, the windings become too hot and the efficiency consequently very low. He claims to have overcome this by passing the wires through holes in the iron near to the surface; to this fact he claims the success of the multiphase motors is due. Another defect was in the form of the magnetic circuit with projecting poles, producing reactions which render starting difficult. Still another objection was the high frequency used, principally in America.

The new principle of his motor is based on what he calls the remarkable phenomenon, which he claims to have discovered, that a conductor in an alternating field, if set rotating with a certain velocity, will itself run up to practically synchronous speed, having a tendency to keep this speed. Currents are induced in the conductor by the alternating field; while at rest these currents are neutral with regard to the field, but as soon as there is motion a torque is produced. With a conductor, in the form of a solid disc, the speed will be below that of synchronism; with one consisting of few members, the tendency is to preserve almost exact synchronism; but if the speed be reduced the torque decreases rapidly. The direction of rotation is indeterminate, depending on how the motor is started. The following are important points in designing such motors: The alternating field must be as strong as possible, and all magnetic resistances in both primary and secondary circuits must be reduced to a minimum; eddy currents must be avoided as much as possible. To accomplish this last, the induced and the inducing windings should be provided with laminated iron cores. To reduce the magnetic resistance the windings are imbedded in iron by any of the well known methods. The induced winding is usually made the rotating part, as this avoids sliding contacts, its coils being merely short-circuited windings preferably insulated from the coil. This short-circuiting may be carried out in any of the well known ways. If it is required to regulate this induced current, it must be led off by sliding contacts.

Figs. 1 and 2 show a form of this motor. It will be noticed that with the exception of the inducing winding, it is precisely like the three-phase motors already fully described in The Electrical World. The inducing winding W is so connected as to form two poles P P_1; the rotating part contains a simple short-circuited winding made of copper bars passing through holes near the surface and all connected to two copper rings at their ends. If these copper bars are few in number, the motor

will have the property of being almost synchronous. He states that his motors have a remarkably high weight efficiency. One weighing 350 pounds, for instance, at 2,000 revolutions gave 6 h. p. without excessive heating; its efficiency was very good, and the apparent watts were but slightly more than the true watts; he states that it is scarcely behind direct or multiphase current motors. He then speaks of calculating the "idle" or magnetizing current, which it is very necessary to calculate in such motors. He recommends Kapp's formula and Hopkinson's method.

His motors have similar properties to multiphase motors in every respect, except that they will not start by themselves. He suggests the following methods of doing

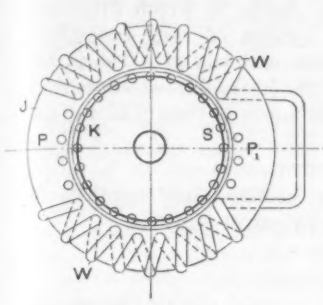


FIG. 1.

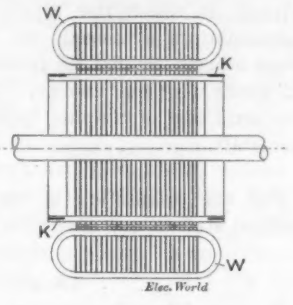


FIG. 2.

this. By providing a second winding which, being in action only a short time, may have but a small section; by giving this a self-induction different from the first and connecting the two in parallel, the resulting phase difference produces a rotating field, which starts the motor, after which the second winding is cut out. This difference of phase can be produced in various ways; one is to wind one section as drum and the other as a ring, as in Fig. 3, the latter having considerably greater self-induction than the former; or by connecting a self-induction, as in Fig. 4, or a capacity, as in Fig. 5, or a resistance, in series with one section; this may be used with the above described mixed winding. As a convenient way for obtaining the capacity, he suggests a series of iron dishes mounted in a pile insulated from each other and filled with a solution of soda. Transformers may also be employed for obtaining phase differences. With a 1 to 1½ h. p. motor he has obtained a torque corresponding to a load of 3 h. p. at full speed. Another method is to provide the induced winding with a collector and brushes; the brushes are first short-circuited and, after starting, the commutator is short-circuited by a ring; in this case a simple, normal, winding is required for the inducing current, but the induced winding must be an insulated one, as in the usual motors. Motors may be built of all sizes up to 100 h. p. and more. He believes these motors will displace multiphase motors in mixed circuits for lighting and power, but for power distribution alone, he states, that multiphase motors will still be used.

Brushes.—Further information regarding the new brushes mentioned in these columns last week states that they are made of an alloy of copper, zinc and silicium, the proportions of which are kept a secret. Bands of this metal about 7 inches wide are corrugated and bent, and by means of pressure are compressed into brushes

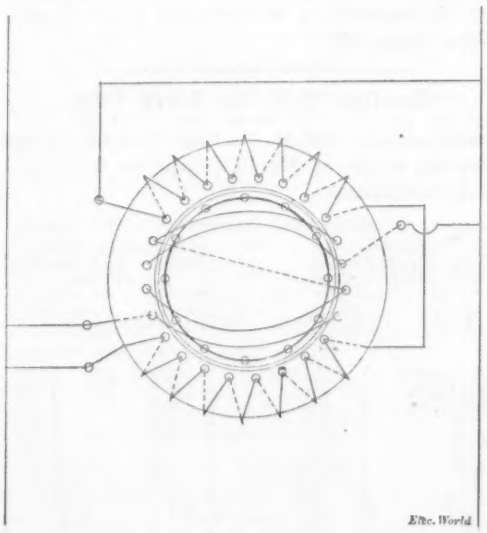


FIG. 3.

of suitable dimensions. The alloy is very malleable, and possesses anti-friction qualities. The brushes are said to preserve the commutator, and they wear off only very little. They have been in use for a year on an electro-plating machine of 600 amperes, working continuously 10 hours a day; the commutator becomes polished and does not wear off.

ARC AND INCANDESCENT LAMPS.

In a lecture by Mr. Feldmann, he states that according to Prof. Weber the temperature of the incandescent lamp filament, running normally, is from 1,000 to 1,200° C.; if forced to 3,000° it will destroy the filament. At the normal temperature it will have a life of from 800 to 1,200 hours running at 3.5 watts per candle; if run at half the voltage the life will be in the ten thousands and the efficiency will be 120 watts per candle.

"La. Lum. Elec.," Jan. 28, continues its long and profusely illustrated serial on arc lamps taken, it appears, chiefly from patent specifications.

A foreign journal suggests a new application of incandescent lamps. Before putting on one's shoes in the morning a lighted incandescent lamp is placed in each shoe, thus bringing it up to a comfortable temperature. Another journal adds that if two lamps are placed in series the current required will be so small that it will probably not start the meter and will therefore cost nothing.

TRANSMISSION OF POWER.

Losses in Mechanical Transmission.—Mr. Thwaite, in an article published in Lond. "Elec. Rev.," Feb. 3, gives some interesting information, in the form of an appendix to his recently published paper. He cites the case of the locomotive works of the Northern Railroad of France at Creil, in which a saving of 50 per cent. of power was attained by introducing electric motors in place of the shafting. In another case investigation showed that in a certain factory in France in which shafting and belting were used, not more than 7 per cent. of the power consumed is utilized in doing actual work. He says that individual machines absorb much less power than is generally supposed, and urges every power user to ascertain for himself the amount of power absorbed by each of his machines, which will show him how great the losses in shaft and belt transmission are. He sums up the well known advantages which would be gained by replacing shafting transmission by individual electric motors. He gives the data for a plant in England where electric distribution and transmission are used, among which may be quoted the following interesting figures: A planing machine capable of planing 20 feet by 12 feet

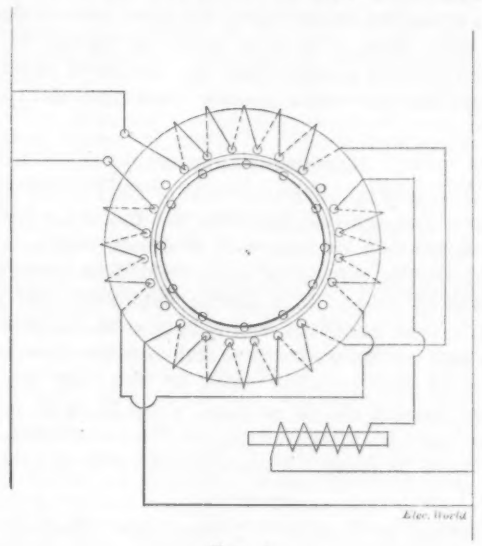


FIG. 4.

by 8 feet high and having a traveling table weighing 17 tons, when planing an ordinary bedplate casting, the electric energy absorbed when cutting averages 105 volts and 30 amperes; in the return motion slightly less is used, but at the moment of reversing the power is 105 volts and 100 amperes. A 10-ton crane traveling 50 feet per minute on a level track, and lifting at the rate of 9 feet per second for the fast gear and one-half this for the slow gear, absorbs the following energy in the motor:

Lifting seven tons, slow gear	70	amperes	106	volts
Lowering seven tons, slow gear	26	"	108	"
Lifting empty, rapid gear	18	"	110	"
Lowering empty, rapid gear	8	"	110	"
Traveling along the shops	20	"	109	"
Lifting nine tons, slow gear	110	"	105	"
Lowering nine tons, slow gear	50	"	110	"
Traveling along shops with nine ton load	25	"	110	"
Traveling across shops with nine ton load	25	"	110	"

In shops using heavy tools he quotes from Flather that the power used by the machinery itself will average 40 to 50 per cent. of the total power expended; this includes elevators, fans and blowers. In shops using light machinery and a foundry, results would be the same, but without the foundry the loss of power in the transmission would be from 30 to 40 per cent. In conclusion he says that with electric transmission a saving varying from 16 to 75 per cent. may be obtained.

RAILWAYS.

"L'Electricien," Jan. 28, gives a short description of a new trolley road at Marseilles. Among other points of interest it was stated that the overhead lines are supported on oil insulators; that the efficiency from the pulley of the steam engine to the end of the line is to be 52.5 per cent.; and that the guaranteed cost of traction is 7.3 cents per car mile for a mean of 720 miles per day; it is constructed entirely by European firms.

CENTRAL STATIONS.

Messrs. Brew and Ledger read a paper on Central Station Notes, of which a long abstract may be found in the Lond. "Elec. Eng.," Jan. 27, p. 106, and a shorter one in Lond. "Electrician," Jan. 27, p. 363. The first part of the paper is devoted to boilers and engines, including a description, at some length, of governor tests. They show that when special steaming boilers are used for short periods, about double the price must be paid for an indicated horse power hour compared with similar boilers running continuously. This might be improved

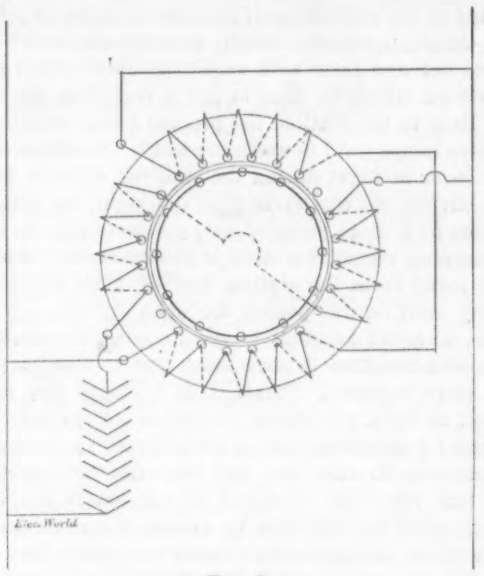


FIG. 5.

by keeping on hand a supply of heated feed water. They speak of the importance of excluding oil and grease from the water used in boilers, also of the importance of measuring and testing every piece of the plant in the station periodically. In high speed direct coupled engines and dynamos they find the loss in the dynamos to be from 5 to 10 per cent., and in the engines from 10 to 18 per cent. Regarding dynamos they say it is a well known fact that an over-compound dynamo will not run satisfactorily as a generator supplying a shunt motor if both be nearly the same size. Another fact is that two over-compound dynamos will not run satisfactorily in parallel, neither will two so-called compound dynamos whose characteristics deviate much from a straight line. Let Fig. 6 represent two compound dynamos whose series windings are s, s and let w represent the equalizing wire, A and B representing the mains. Supposing the bars A and B to have little or no resistance, the connections reduce themselves to the Wheatstone diagram Fig. 7, in which the balancing wire replaces the galvanometer. Letting x, y and z denote the currents in the various sections, they show that the current through the balancing wire will be proportional to the difference in the electromotive forces of the two machines. They then show that if r_5 is 0, and $r_3 = r_4$, then the currents in the series windings will be equal; or in other words, if the series windings have an equal resistance and if the resistance of the equalizing wire is small, then whatever be the difference between e_1 and e_2 or r_1 and r_2 the currents through the series windings will be nearly equal. This shows that in order that two compound machines may be run in parallel they should be of the same size or at least have equal resistance in their series windings, and that the equalizing wire should have a low resistance, and not a high resistance as is sometimes stated. They then show the characteristics of some compound machines which would not work in parallel, showing how parallel connection depends on the characteristic curves. They then show some curves giving the lag of the magnetism through the armature, behind the magnetizing current (for these curves see Lond. "Electrician," Jan. 27). This lag, they claim, also has

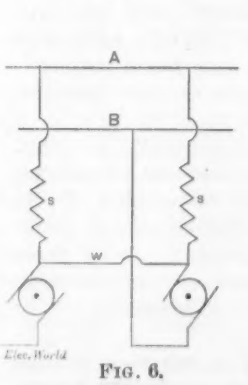


FIG. 6.

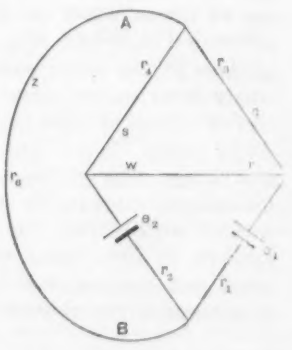


FIG. 7.

an effect in running machines in parallel when the load fluctuates rapidly. An effect of importance, on the steady current flowing through the shunt winding, will be produced when the main switch is closed, which effect is that due to mutual induction between the shunt and the main circuit through the armature and series windings. They speak at some length about regulators and the unreliability of automatic cutouts to protect the dynamos. They give a discussion at some length about the very varying loads on a central station supplying light for an opera house or theatre, giving load diagrams for the same. They conclude their paper by urging the necessity of frequently checking the accuracy of the voltmeters and ammeters and describe a method by which this may be done,

Locating Trouble on Arc Circuits.—Mr. Poole read a paper on this subject, reprinted in full in the Lond. "Elec. Rev.," Jan. 27. He describes practical methods for finding the faults on open, crossed, and grounded circuits. His methods are understood to refer to series circuits. For finding an open circuit both legs are grounded at the switchboard; the lineman goes to a lamp on the circuit, opens the circuit, grounds one side of his magneto bell and tests both ways; the open circuit is on that side on which he fails to get a ring; this circuit is traced back to the station, the process being repeated at successive lamps until he finds the fault. Should an open circuit occur at night during the run, the dynamo is left on the circuit, the attendant goes out along the line and by means of a short piece of wire connects the outgoing and returning wires; if a flash is produced the fault lies farther away from the station, and he must proceed in this way until he has passed the open circuit. For this purpose, to avoid accident to the lineman, a sufficiently low tension machine is sometimes put to line in place of the large machine. Tests with a bridge and galvanometer, he says, are almost worthless except for trunk lines and for short circuits on trunk lines; by measuring the resistance in this case and knowing the resistance of the line wire, the fault can be located in the usual manner, which he describes by means of an illustration. To find crosses between two circuits they must first both be cleared of any grounds, after which one of the two circuits is grounded at the station; the lineman with his bell starts out on the other circuit and proceeds similarly to finding an open circuit, as described above, only that the bell will ring instead of failing to ring when he has passed the point; when the bell rings the cross lies between that point and the station. By far the most frequent faults are grounds. The magneto bell may be used as described above, by opening the circuit and testing both ways. He prefers to use a voltmeter reading from 0 to 3,000 volts; the circuit is then tested while running. He measures the voltage between two wires at the switchboard, then between each terminal and the ground; by calculating the number of volts used in each lamp and in its proportion of the line wire, the measurements between the two ends and the ground, will show between what two lamps the ground occurs. The same method will show where two grounds occur, making due allowance, first, for the number of lights cut out between these two grounds. He illustrates this method very fully by means of examples.

"L'Industrie Electrique," Jan. 25, gives a long list of all the central stations in France for the 1st of January, 1893, also a map of France, showing the location, whether alternating or continuous or both, or whether only projected. The table gives tabulated information about each of the stations. It is quite complete, but is too large to admit of any deductions; in general, however, the following may be mentioned: Almost all of them include public lighting; the majority use steam power, although quite a large number are run with water power. All but a few are below a few hundred horse power, many being below one hundred; most of them use French dynamos; by far the larger number use continuous currents of 110 volts or thereabout; several use continuous currents as high as two and three thousand volts; alternate current distribution is the exception; the price of gas is given and it appears to average about 30 centimes per cubic metre, which is equivalent to about $1.70 per thousand cubic feet.

"L'Electricien" concludes its list of central stations erected in France during the past year. The following general conclusions may be of interest: A large number of towns which were not provided with gas have introduced electricity in preference. Out of a total of 80 stations 51 use water power, as it was found that electricity from water power is so much cheaper than gas. Out of a total of 7,841 horse power about 50 per cent. is water power, 45 per cent. steam power and 5 per cent. gas power. The different systems used are as follows: Continuous currents in series, 1; in parallel, 25; in parallel with battery, 14; with continuous current transformers, 2; with three wire systems, 17; with three wires and accumulators, 4; alternating currents with transformers, 11; tri-phase alternating currents, 6.

In order to determine the effect on telephone circuits of grounding the neutral wire of lighting circuits, experiments have been made in Berlin in which it was found that it was advantageous to telephone circuits to have the neutral wire of lighting circuits grounded. The disturbances noticed in the telephone circuits were that the annunciators dropped when short circuits occurred in the lighting circuits. The experiments showed that the number of annunciators which dropped were very much greater when the neutral wire was insulated than when it was grounded; it is therefore a protection to telephone circuits in which grounded returns are used to have the neutral wire of lighting circuits grounded. The disturbances occur when accidental grounds are produced in one of the three conductors; a short circuit between two of the conductors does not produce any disturbance; when the neutral wire is grounded the grounding of one of the others is in the nature of a short circuit, the action of which is quite local, while the earth current passes chiefly through the grounded neutral conductor.

In "L'Electricien," Jan. 28, Dr. Palaz gives a practical method, stated very clearly, showing how to calculate the accumulator plant required for a central station. The article does not admit of being abstracted. It is recommended to those interested in this subject.

TELEGRAPHY.

Balloon Signaling.—Mr. Bruce read a paper on electric balloon signaling in London, an abstract of which will be found in the Lond. "Elec. Rev.," Feb. 3. He describes a system which he has experimented with successfully. The balloon is made of translucent material, namely thin cambric coated with varnish; it is filled with pure hydrogen or coal gas; in the interior of this balloon—that is, in the space occupied by the gas—are six incandescent lamps of 8 c. p., but worked to a much higher power; he uses very thin filaments in order to increase the speed of signaling; they are connected by a double cable, weighing 30 pounds per 500 feet, to a storage battery or dynamo on the ground; the battery comprises 25 cells, weighing about 600 pounds. The gas may be supplied from iron cylinders in which it is compressed. He used two balloons, one containing 4,200 cubic feet, having a diameter of 20 feet, and the other containing 1,600 cubic feet, having a diameter of 14 feet, and found the former to be most satisfactory. Filled with pure hydrogen it will lift over 1,000 feet of cable. The smaller one was suitable for a naval signal; he proposes using the Morse code, but uses a key having carbon contacts; the signals were visible a distance of 16 miles. Placing the lamps inside of the balloon avoids the indistinctness or blurring of the signals due to a gradual dying out of the light. To show that no danger would arise from a broken lamp or spark in the hydrogen gas, he heated wires and produced sparks in glass jars through which gas was being passed.

ELECTRO-CHEMISTRY.

Preparation of the Hydrated Oxide of Lead.—The "Rev. de Chimie Industrielle" describes the following process: Electrodes of lead are immersed in a bath with a 10 per cent. solution of nitrate of soda, divided into two compartments by means of a porous diaphragm. On passing the current, nitrate of lead is formed on one side and caustic soda on the other; these solutions are then mixed in a second tank in which oxide of lead will be precipitated, leaving nitrate of soda, which is again passed into the first bath after filtering out the precipitate. One ampere-hour produces 4.5 grammes of oxide of lead.

Preparation of Indigo.—"L'Electricite" describes the following process in making indigo: The dried plants are steeped in water and the yellow liquid thus formed is oxidized by means of an electric current in wooden tanks with copper electrodes. The indigo thus formed by the oxidization is said to be purer and finer than that produced in the usual way.

Preparation of Vermilion.—The "Rev. de Chimie Industrielle" describes the following process: In a wooden bath 1 metre in diameter and 2 metres high are placed circular shelves about 6 inches wide on which is placed metallic mercury about ½-inch deep; these shelves are connected with the positive pole of the dynamo. At the bottom of the vat is a plate of steel-plated copper connected with the negative pole. The solution contains 8 per cent. of nitrate of ammonia and 8 per cent. of nitrate of soda. Through a perforated worm placed in the bath, sulphuretted hydrogen is introduced. Besides this the bath contains agitators. On passing the current, a precipitate of sulphide of mercury, that is, vermilion, is formed. Another method which is being tried, is to use a bath containing 100 litres of water, 4 kilogrammes each of nitrate of ammonia, nitrate of soda, sulphide of sodium and sulphur. In this case one has only to add sulphur and mercury instead of sulphuretted hydrogen.

Bleaching.—In a report to a French society on the Hermite process, the following information is given, which, being probably impartial, is, doubtless, reliable. The liquid used is 1,000 parts of water, 50 parts sodium chloride, 5 parts magnesium chloride. It states that only the magnesium chloride and the water appear to be decomposed and form a strong bleach compound at the positive pole; no free soda is produced, as has been claimed. One electrolyzer in 24 hours produces the equivalent of 220 pounds of dry chloride of lime at a cost of $1.04 if hydraulic power is used, and $2 if steam is used.

Electroplating China.—The Lond. "Elec. Rev." states that if the surface of articles in china and porcelain be coated with a paste made of 120 parts (by weight) of nitrate of silver, 20 parts ammonia chloride of mercury, 30 parts bromide of sodium, 10 parts oxide of bismuth and then fired, they may be electroplated with a strongly adherent metallic coating. This may be used for decorating purposes or for giving them additional strength; a thick deposit of copper, for instance, is said to greatly strengthen handles, spouts and like parts.

Accumulators.—In a long lecture on Portative Electrical Energy, published in the Lond. "Elec. Eng.," Jan. 27, Mr. Niblett gives a review, in a semi-popular style, of the present applications and possibilities of electric light and power supplied from portable accumulators. It scarcely admits of being abstracted. It is, of course, favorable for accumulators. He traces at some length the subject of portable lamps for miners, giving results of tests made in France, in which the "Stella" lamp, in which lithanode accumulators are used, are spoken of very favorably. Such a lamp weighs 4½ pounds, and will give 1 c. p. for 12 hours with one charge. The tests quoted state that the total cost of running these lamps is from 3 to 4 cents per shift.

For the calculation of the accumulators required in central station, see note under Central Stations.

MISCELLANEOUS.

A new furnace described in the Lond. "Engineer" consists of two bricks of quicklime, one upon the other, the lower one of which is provided with a longitudinal groove, which carries the two electrodes, and between them is a small cavity, serving as a crucible, which contains a layer of several centimetres of the substance to be experimented upon. The latter may also be contained in a small carbon crucible. The highest temperature worked with was 3,000 degrees C., produced by a current of 450 amperes and 70 volts, consuming 50 h. p. In the neighborhood of 2,500 degrees, lime, strontia and magnesia crystallized in a few minutes. At 3,000 degrees the quicklime composing the furnace began to run like water. At the same temperature the carbon rapidly reduced the oxide of calcium to the metallic state. The oxides of nickel, cobalt, manganese and chromium were reduced in a few seconds at 2,500 degrees, and a button of uranium, weighing 120 grains, was obtained from the oxide in ten minutes at 3,000 degrees.

According to the Lond. "Engineer," Mr. Danchell, a Danish engineer, claims to be the original inventor of gutta-percha covered wire, which he invented in 1840 to 1845. The first wire used, he says, was in 1847 between Berlin and Frankfort. Mr. Alexander Siemens, in the same journal, claims that Dr. Werner von Siemens was the original inventor, and substantiates his claim by referring to a legal decision in New York, in which the matter was investigated.

Mechanical Applications.—"La Lum. Elec." continues its long and profusely illustrated serial on the mechanical application of electricity, which appears to be compiled, to a great extent at least, from patent specifications.

Duties.—"Electrical Plant" of January gives a list of the rates of import duty on electrical machinery in all the principal civilized countries. Those referring to the British colonies, though not so stated, may depend on whether the machinery is imported from England or from other countries.

Moonlight Table for March, 1893.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of March, under his modified form of moonlight schedule:

TABLE NO. 1. Standard Moonlight. Philadelphia System.

Date.	Light.	Date.	Exting.
1	No light.	1	No light.
2	No light.	2	No light.
3	6:20 P. M.	3	8:20 P. M.
4	6:20	4	9:10
5	6:20	5	10:10
6	6:30	6	11:10
7	6:30	8	12:10 A. M.
8	6:30	9	1:10
9	6:30	10	2:20
10	6:30	11	3:20
11	6:30	12	4:10
12	6:30	13	5:00
13	6:30	14	5:20
14	6:30	15	5:20
15	6:40	16	5:10
16	6:40	17	5:10
17	6:40	18	5:10
18	6:40	19	5:10
19	7:10	20	5:00
20	8:30	21	5:00
21	9:40	22	5:00
22	11:00	23	5:00
23			
24	12:10 A. M.	24	5:00
25	1:10	25	5:00
26	2:10	26	4:50
27	2:50	27	4:50
28	3:20	28	4:50
29	3:50	29	4:50
30	No light.	30	No light.
31	No light.	31	No light.

Total hours lighting, 178.40.

TABLE NO. 2. Frund's New Moonlight System.

Date.	Light.	Date.	Exting.
1	6:20 P. M.	1	12:00 M.
2	6:20	2	12:00
3	6:20	3	12:00
4	6:20	4	12:00
5	6:20	5	12:00
6	6:30	6	12:00
7	6:30	8	12:10 A. M.
8	6:30	9	1:10
9	6:30	10	2:20
10	6:30	11	3:20
11	6:30	12	4:10
12	6:30	13	5:00
13	6:30	14	5:20
14	6:30	15	5:20
15	6:40	16	5:10
16	6:40	17	5:10
17	6:40	18	5:10
18	6:40	19	5:10
19	6:40	20	5:00
20	6:40	21	5:00
21	6:40	22	5:00
22	6:40	23	5:00
23	6:40	24	5:00
24	6:50	24	12:00 M.
25	1:10 A. M.	25	5:00 A. M.
25	6 50 P. M.	25	12:00 M.
26	2:10 A. M.	26	4:50 A. M.
26	6:50 P. M.	26	12:00 M.
27	2:50 A. M.	27	4:50 A. M.
27	6:50 P. M.	27	12:00 M.
28	6:50	28	12:00
29	6:50	29	12:00
30	6:50	30	12:00
31	6:50	31	12:00

Total hours lighting, 255.40.

Institution of Electrical Engineers—.II.

INAUGURAL ADDRESS BY WILLIAM HENRY PREECE, F.R.S., PRESIDENT, DELIVERED JAN. 26, 1893.

VI.—DOMESTIC APPLICATIONS.

The era of the application of electricity to domestic purposes may practically be said to date from about the year 1850, when Hipp, of Neufchatel, introduced into the Berne Chamber of Deputies a system of electric bells. The system was taken up by Breguet, of Paris, and largely introduced by him in France. The system, as arranged by that inventor, was brought to England by me in 1863, and taken up by Messrs. Adams, the well known firm of ironmongers of the Haymarket. Although some time elapsed before the system took a firm hold, its subsequent progress was very rapid, and now forms a very flourishing branch of electrical industry.

There can be but little doubt but that the success which electric bells for domestic purposes have attained has been mainly due to the introduction, in 1866, of the Leclanche battery. The perpetual attention which Marie, Davy and Daniell cells (the form of batteries at first employed for the purpose) required must have very seriously, if not fatally, hampered the march of the most successful of the domestic applications of electricity, had the invention of the Leclanche battery not come to the rescue.

Water-level apparatus, though perhaps not strictly classifiable with domestic appliances, in so far as they are closely connected with water supply, may be alluded to. In the International Exhibition of 1862 an apparatus of this kind, devised by MM. Mouillon and Vinay, was shown in action; and within the last 15 years the Postal Telegraph Department has fitted and maintained with great success special forms of instruments, designed and worked out by Mr. H. R. Kempe, for various water companies.

Electric clocks have been a very favorite subject for invention, and were introduced in the very early days of the electric telegraph; an enumeration of the patents taken out for these appliances would run to a very long list, but the record, with a few marked exceptions, is practically one of failure, representing much ingenuity but little real utility. We use in several post offices systems of electrically controlled clocks that work very well.

Electric hoists, devised by Siemens, Hopkinson, Crompton and others, have been used to some small extent; but their introduction has not been so extensive as might have been anticipated. One cause of this is, no doubt, the want of a good self-starting alternate-current motor; but it is more especially due to the question whether at present high prices electric energy for the purpose can financially compete with the generally adopted means of working the hoists.

For ventilation purposes on a small scale, the adoption of fans should prove of considerable value, as such fans can be placed in any convenient place out of sight and be contained in a very small compass.

Heating and cooking apparatus worked by electricity have not at present a very favorable outlook, though many appliances of the kind have been shown in operation, especially at the recent Crystal Palace Exhibition. The question is far more a financial one than anything else, and the public have not yet been educated up to the point of paying heavily for "biftek a la Francaise" because it is cooked on highly scientific principles. I have in use in my house a flatiron, a tea kettle, and a curling-tongs heater, each heated electrically.

I must not omit to mention the large use of "electric gaslighters," an invention which has hardly received the full credit which it deserves.

VII.—ELECTRO-CHEMICAL INDUSTRY.

The electro-chemical industry is, financially, one of the most important in this country. Electro-plating was started by Elkington at Birmingham in 1840. There are now about 170 electro-platers in Sheffield, and over 100 in Birmingham. Christophle, of Paris, deposits annually six tons of silver.

Nearly the whole of the copper used for conducting purposes in the various applications of electricity is extracted from its impure ores by electro-deposition. 0.3 h. p. continuously applied deposits 1 pound of copper per hour, and this costs about 0.1d., so that the process is very cheap while the effect is wonderful, for copper is now frequently supplied having a conduction of 102 per cent. of pure copper. This is due to the fact that the specific gravity of the material has been raised from 8.90, at which Matthiessen took it in 1862, to 8.95, which is now obtained with hard-drawn electro-deposited material.

Aluminium is being extracted in large quantities from cryolite in England and in the United States (Pittsburgh). In Switzerland water power at Neuhausen—the falls of the Rhine—is being very successfully employed for the same purpose. The price of the metal has, in consequence, fallen very much, but the demand is greater than the supply, and the price is rising.

Many attempts have been made to produce caustic soda and chlorine from common salt, especially for bleaching purposes in the paper industry; but all the difficulties in the case have not yet been surmounted, the principal one being the destruction of the anodes—at any rate, the industry is not a staple one at present. An interesting process, by which phosphorus was separated from apatite, a mineral phosphate, by the dissociating effect of the terrific heat of the electric arc, was developed by Readman, Parker, and Robinson, at Wednesfield, near Wolverhampton; but though the right to use this mode of producing phosphorus was purchased at a very high figure by those who have the monopoly of that business, it does not appear that it has been put to practical use at present. Great advances and developments are being made in other directions, notably in the production of ozone, in electrical bleaching, and in reduction by the electrical furnace.

There are few oxidizing and reducing processes in chemical industry which cannot be effected economically and with advantage by the electric current, and the extreme cheapness with which electrical energy can be manufactured when used continuously, and when produced by falling water, as well as the extreme purity of the resulting deposits, are calling earnest attention to this lucrative branch of the business. It is not impossible to produce a kilowatt-hour of electrical energy by means of water power for 0.1d., and when this is stated to be equivalent to gas used for illuminating purposes at 0.6d. per 1,000 cubic feet, it will be seen what a potentiality of wealth there is in this (at present) much neglected waste energy of nature.

VIII.—ELECTRIC LIGHTING.

Although the arc lamp was invented very early in the century, and the glow lamp made a fitful appearance in 1845, it was not until Jablochkoff startled the world with his candle in 1877, and Edison and Swan perfected the carbon filament of high resistance in 1880-81, that the electric light began to attain its practical stage. Its rapid development has been seriously retarded in England by the operations of a monster called into existence by the limited liability legislation of recent years—the rapacious financial promoter—whose plunder in one year of our period far exceeds in amount the sum of all the thefts of all the highwaymen and burglars that were ever hung. He has ruined the prospects of private enterprise, and has rendered absolutely necessary the acts of 1882-88, which have thrown the industry into the hands of the local authorities of our cities and boroughs.

The glow lamp has been greatly improved, and as this year will witness the expiry of the controlling master patent, we shall see the price reduced to something not far from 1s. Some of us can remember the time when the price was 25s. It has now for some time been 3s. 9d. As a glow lamp costs only 9½d. to make, we may reasonably hope that my anticipation will be realized.

The cost of wiring is a great deterrent to the introduction of the electric light into small tenements and into houses held on short tenures. The materials used must be of the most perfect kind, otherwise insecurity is incurred; but there are expensive practices of wood casing and of ornamentation which want reform. The Cheap Jack is the curse of the industry, and the absence of specification and of inspection the danger of the user. The fire insurance offices have maintained our practice in England pretty secure, but in other countries the character of the work has been very indifferent.

The problem of economic distribution has been much simplified by the introduction of the three-wire system by Dr. John Hopkinson, and by the improvements made in high-pressure apparatus. High pressure not only economizes the heavy cost of mains, but simplifies immensely the mode of regulation. The early pioneer alternate-current systems, which have done so much to further the development of electric lighting, were, however, costly in their coal bills, owing to great losses of energy in their iron and copper, but the transformer of the present day is as perfect in efficiency as the dynamo. These losses have practically disappeared, and modes of switching transformers in and out at will have removed every difference of cost between high-pressure and low-pressure systems. The prejudice against high pressure is still strong, but time and experience will eradicate it as they ultimately eradicate every fallacy. The prejudices against high-pressure steam and against high speed on railways were once equally strong, but those prejudices survive only as "bees in the bonnets" of a few.

The progress in electric lighting is now principally economical. The cost of production of electrical energy is rapidly coming down. Elements of waste are being eliminated, and continuous working throughout the day and night is being encouraged. If a full load could be maintained during the whole 24 hours, electrical energy could be manufactured for one-third of a penny per supply unit, and this is equivalent to gas at 2d. per 1,000 cubic feet. The potentiality of economy in electric lighting is thus beyond the dreams of the gasman. The most marked features in the development of this great industry are the ostrich-like blindness of the gas manager, who buries his foresight in his fat dividend, and the childish wailing of their technical journalists. The gas industry should itself have nursed this herculean infant who is rapidly strangling one of its main sources of profit. Fortunately for the gas shareholder, there are other sources of income—warming, cooking, motive power—to be developed. Our corporations and local authorities are showing more astuteness. Manchester, Nottingham, Dewsbury, though successful gas producers, have assumed also the position of undertakers of electrical energy.

Monopolies are held in pious horror by the critical public, but it fails to draw a distinction between a monopoly held by the few for their own personal benefit at the expense of the many, and that held by the many for their own purposes comforts and economies. Electric lighting, carried out under the provisions of the acts of 1882 and 1888, is a self-supporting, self-managed and profitable industry. It is a business of a mutually co-operative character, carried on by the ratepayers themselves for their own sole benefit.

The bright illumination of our streets increases their security, not only from crime, but from accident. Accidents in large towns are relatively greater during the hours of darkness than during daylight. The amount of light distributed over the roadway by an ordinary street gas-burner is very small, but arc lamps can be so distributed as to rival daylight in their illumination. If anyone wants to know what can be done in this direction, let him visit Spiers & Pond's establishments in Water Lane, Blackfriars.

The rate of growth of the industry is shown by the following returns:

	London.
Dec. 31, 1890	145,000 electric lamps fixed
" 1891	330,000 " "
" 1892	500,000 " "

	Bradford. (Lamps.)	St. Pancras. (Lamps.)	Brighton. (Lamps.)
1889	1,000	.....	.....
1890	8,467	.....	.....
1891	15,000	13,000	2,572
1892	20,000	21,000	10,248

Nothing can stop the growth, or prevent the rapid spread of, this beneficent and sanitary mode of illumination into the confined, ill-ventilated, overcrowded homes of the working population. The electric light is essentially the poor man's lamp.

Many efforts are being made to utilize the waste forces of nature in producing electric currents for the economical supply of the light. In America, Scotland, Switzerland, Italy, and, indeed, wherever waterfalls are available, electric plants are being installed to convert the energy of the falls into the useful form of electricity. At Tivoli, near Rome, a fall of 165 feet is used to work six turbines of 350 h. p. each, giving 2,100 h. p. in all. Six high-pressure alternators working in parallel send electrical energy at over 5,000 volts pressure to Porta Pia, near Rome, 14.8 miles from Tivoli, through four stranded copper conductors, each having a diameter of 13 millimetres, and bunched into one metallic loop, giving a total resistance of 4 ohms. At Porta Pia the 5,000 volts are reduced to 2,000, and the currents are distributed to several sub-stations spread over the city, where they are again lowered to the safe pressure of 102 volts, at which voltage the current is supplied to the consumer on the three-wire system. There are 600 arcs and 30,000 glow lamps in use in Rome, but they are not all supplied from Tivoli. I inspected this installation only a few days ago, and found everything working smoothly and efficiently under the able guidance of Professor Mengarini.

Water power abolishes the coal bill, but it must be remembered that the cost of maintenance of machinery and of the erection and keep of conductors limits the distance to which the energy of falling water can be economically transmitted. The proposal to light New York by currents generated at Niagara is at present financially absurd. It is doubtful whether it will be commercially advantageous at Buffalo, 30 miles away, but it is certain that at Tivoli it can be so applied with advantage and profit.

There is much water power in this country that might be usefully employed. At Worcester it is proposed to use the water of the Teme, a tributary of the Severn, to supply electrical energy to the city—an experiment that will be watched with considerable interest, for the use of water power will solve the difficulty occasioned by light loads during the small hours and daylight. Keswick and Lynton have already been so served, but on a small scale only.

There are many towns whose public streets could be brilliantly illuminated by the streams running past them, but there is much fear and distrust to be removed from the minds of our local magnates, and a considerable amount of education necessary before the public will receive the full value of the gifts that nature so freely places at its disposal, and the engineer so thoroughly converts into a utilitarian form.

The rippling brook, the rhythm of falling water, the flowing tide, and the stream that rushes wildly over well-worn bowlders have furnished the poets of all ages with imagery and with illustration.

"All nature rejoices
And moves with a musical flow."

But no poetry of the past surpasses the poetry of the modern engineer, who transforms this musical flow into a gentle form of silent energy that answers the first fiat, "Let there be light," and that gives comfort to the home, health to the being and security to the worker.

IX.—POWER TRANSMISSION.

The oldest proposal for transmitting power electrically over a distance is probably that contained in the patent specifications of H. Pinkus, who proposed, in 1840, to work an electric railway by power obtained from large primary batteries established on the line, but not carried on the trains. Pinkus must have contemplated transmission of current by wire. The first time power transmission publicly shown was by Fontaine in the summer of 1873 at the Vienna Exhibition; but whether the discovery of the reversibility of the dynamo and of the possibility of transmitting energy from a generator to a motor through a long length of cable was purely an accident or the outcome of conscious investigations is not known. The story is told of an attendant who, when tidying up the stall of the Gramme company, saw two cable ends lying loose, and, thinking they belonged to a Gramme dynamo near by, inserted them into its terminals. The machine immediately began to revolve, and it was then found that the other ends of the pair of cables were attached to another machine which was working. The transmission of power by means of two Gramme dynamos was also shown at the exhibition of scientific apparatus in South Kensington, in 1876. Although experiments of this kind were repeated by various scientists, the discovery seems to have been left undeveloped until Messrs. Chretien and Felix applied it, in 1878, on a practical scale for working an elevator, and in 1879 to agricultural work. The generator was a Gramme dynamo at the Lermaise sugar factory, and the energy was used for plowing a field half a mile away at the rate of 200 square feet per minute, which corresponds to about 8 h. p. in the plow rope. The first electric tramway was that shown by Siemens in 1881 at the Electrical Exhibition in Paris.

Since then the industry has begun to develop, and many electrical engineering firms took up power transmission. In 1882 Mr. Gisbert Kapp discovered that it was possible to get constant speed at the motor under extreme variations of load if the generator and motor were series machines and had characteristic curves which corresponded to each other. He applied the discovery for working the patternmakers' shop at Messrs. Crompton's works at Chelmsford, where the load was, of course, liable to great variations. This principle has since then been used by Brown and others in a number of power plants on the Continent. It is also used for working machine tools, travelers' and other shop appliances; and in Messrs. Denny's shipyards at Dumbarton there is an extensive system of circuits with terminals so placed that work may be done by electric machine tools on any vessel in the yard. In 1886 Mr. Mordey pointed out that a shunt motor regulates for constant speed under varying load if the supply voltage is kept constant. France has very much developed this industry; in Italy we have magnificent examples in Genoa and Tivoli; but it is in Switzerland, where water power is so abundant, that it has flourished so well.

Ferraris and Tesla in 1888 discovered, independently, the rotary field motor, worked by multiphase alternating currents. With this discovery the range of transmission has been enormously extended, since much higher voltages than are possible with continuous currents can be employed. Meanwhile, power transmission by single phase alternating current has also been developed, the earliest example of magnitude being the electric lighting station at Cassel, designed by Oscar von Miller and started in the beginning of 1891. The Heilbronn three-phase transmission, started a year ago, is working most satisfactorily for distribution of light and power. Inventors are, however, busy on single-phase alternating current motors, so that existing alternating current stations may distribute power as well as light, and Messrs. Ganz & Co., Messrs. Brown & Boveri and the Oerlikon works have already produced serviceable motors working by single-phase current.

(To be continued.)

The Lamp Decision.

CIRCUIT COURT OF THE UNITED STATES, DISTRICT OF ..ASSACHUSETTS. } In Equity.

No. 3,096. Edison Electric Light Company, v. Beacon Vacuum Pump and Electrical Company, et al.

Opinion of the Court.—(Feb. 18, 1893.)

Colt, J. In May, 1885, the plaintiff brought suit in the United States Circuit Court for the Southern District of New York against the United States Electric Lighting Company for infringement of the patent now in controversy, which was granted to Thomas A. Edison, Jan. 27, 1880, for an improvement in electric lamps; and on July 23, 1891, a decree was entered, adjudging the validity of the patent and ordering an injuction and account. Upon appeal to the Circuit Court of Appeals for the Second Circuit, the decree was affirmed in October, 1892. Another suit was then brought in the same Court against the Sawyer-Man Electric Company, and a preliminary injunction was granted pro forma until a decision could be had by the Circuit Court of Appeals, which, on Dec. 19, 1892, affirmed the order, and directed an injunction. Suits were then immediately brought against the Westinghouse Electric Company, in Pennsylvania; the Perkins

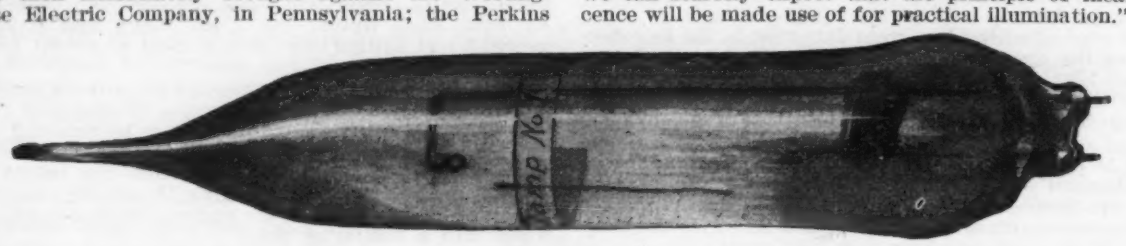


EXHIBIT 1.

Electric Lamp Company, and the Mather Electric Company, in Connecticut, and preliminary injunctions obtained.

The present bill was filed Jan. 10, 1893, and the plaintiff now moves for a preliminary injunction against the defendants, based upon the foregoing prior adjudications. This motion is resisted on the ground of newly discovered evidence bearing on the question of novelty of the Edison invention, which was not before the courts in the other cases. As to these other cases, it is said that there has been but one final adjudication upon the merits, which was in the suit against the United States Electric Lighting Company, that the defendants in the other prior suits were so connected with that company that they were in privity with it, and that therefore injunctions were granted as a matter of course.

The suit against the United States company was thoroughly and obstinately contested, as is shown by the record, which covers about six thousand printed pages, The general rule is that where the validity of a patent has been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open on motion for a preliminary injunction in a subsequent suit against another defendant is the question of infringement, the consideration of other defenses being postponed until final hearing.

The only exception to this general rule seems to be where the new evidence is of such a conclusive character that if it had been introduced in the former case it probably would have led to a different conclusion. The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him.

There is no denial of infringement in the present case under the construction given to the patent in prior adjudications. The contention of the defendant is, that this motion should be denied on the ground that they have recently discovered that Henry Goebel, a German watchmaker, living in New York, invented the Edison incandescent lamp as early as 1854, and that, therefore, the Edison patent is void for want of novelty, or, at least, must be limited to the coiled form of filament. This is the same line of attack upon the patent which was unsuccessfully made in the case against the United States Electric Company. It was there urged that the Starr lamp of 1845, the Roberts lamp of 1852, the Lodyguine, Konn and other lamps, which appeared between 1872 and 1876, the Bouliguine lamp of 1877, the Sawyer and Man lamp of 1878, and the Edison platinum lamp of 1879 limited the Edison patent to narrow inventions or rendered it void for want of patentable novelty. But the Court, with a most exhaustive review of the prior art before it, refused to take this view, and held that the second claim of the patent, read with the specification, covered a broad and fundamental invention, namely, an incandescent lamp, composed of a carbon filament hermetically sealed in an all glass chamber exhausted to a practically perfect vacuum, and having leading-in wires of platinum. Judge Wallace, in his opinion in the Circuit Court, says: "Read by those having this knowledge, the radically new discovery disclosed by the specification is that a carbon attenuated before carbonization as a linen or cotton thread, or a wire 7-1000ths of an inch in diameter and still more attenuated after carbonization, can be made which will have extremely high resistance and be absolutely stable when maintained in a perfect vacuum. It informs them of everything necessary to utilize this discovery and to incorporate it into a practical lamp. It describes, with the assistance of the recital in the second claim, as the vacuum in which the burner is to be maintained, a bulb made wholly of glass, exhausted of air, sealed at all points by the fusion of the glass, and in which platinum leading-in wires are sealed by the fusion of the glass. It describes the materials of which the burner is to be made, and instructs them that the materials are to be shaped into their ultimate form before carbonization. It describes the use of platinum for the leading wires, and a method for securing the leading wires and filaments, intended to dispense with clamping, which consists in molding tar putty about the joints, and carbonizing the whole in a closed chamber."

By this invention Edison disclosed to the world for the first time a practical, commercial incandescent lamp, adapted for domestic uses. The problem was by no means easy of solution.

To subdivide the electric light and embody it in a cheap and durable domestic lamp, capable of successfully competing with gas, had for years baffled the science and skill of the most eminent electricians in this country and Europe. The difficulty lay in the practical construction of a durable incandescent lamp rather than in a knowledge of the elements which should compose such a structure. Carbon burners, platinum wires, exhausted glass receivers were old and well known. As early as 1845 Starr suggested in the King patent a lamp composed of a thin pencil of carbon inclosed in a Torricellian vacuum, and Roberts, in 1852, proposed to cement the neck of the glass globe into a metallic cup and to provide it with a tube for exhaustion by means of a hand pump. Later Lodyguine and others provided their lamps with several short carbon pencils which were successively brought into circuit as the pencils were consumed, also various devices for perfecting the joints between the metal base and the glass globe, while Sawyer and Man, in 1878, made the bottom plate of glass instead of metal, and charged the lamp with an atmosphere of nitrogen gas to avoid destruction of the burner from oxidation. In his 1879 lamp Edison used a platinum burner, which proved a failure because the platinum melted near the point of incandescence. Mr. Schwendler, a noted English electrician, said in 1879, "unless we shall be fortunate enough to discover a conductor of electricity with a much higher melting point than platinum, and which, at the same time, does not combine at high temperature with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination."

The arc lamp was known as early as 1844, but its great light made it unfit for dwellings. The question was how to divide the electric light for domestic purposes. Many scientists considered the problem as hardly within the range of possibility. From the results of the experiments of Fontaine, the French scientist, published in 1877, it would seem that almost insurmountable obstacles, founded on the operation of natural laws, stood in the way of the successful division of the electric light. Mr. Preece, the electrician for the British Post Office, pronounced early in 1879 that "the division of the electric light is an absolute ignis fatuus."

Those who dissented from this view were Mr. Edison, in this country, and Mr. Lane-Fox, in England, who both reached the conclusion that the sub-division of the electric light could be accomplished, provided the radiating surface of the burner of the lamp was reduced in extent so that only a moderate volume of light would be emitted, while at the same time the resistance of the burner was increased so as to enable the employment of relatively small conductors for leading the electric current to the lamps; or, shortly stated, the burner should have a high ratio of resistance to radiating surface. Edison first embodied this discovery in his platinum lamp in 1879, but this lamp was unsatisfactory and the problem remained unsolved. While experimenting with the platinum lamp, Edison discovered that the passage of a current through the platinum during the process of exhausting the inclosed chamber would drive out occluded gases, and thereby raise the melting point of the burner. This led him to secure greater perfection in the vacuum by the employment of a highly exhausted glass chamber similar to those used by Crookes, made entirely of glass, and with all the joints closed by the fusion of the glass. After the failure of the platinum lamp, it occurred to Edison to substitute a short filament of carbon in place of the long platinum burner, into the nearly perfect vacuum chamber, and it was found that such filament was stable at high temperature and free from disintegration and oxidation. It was thus made known that the disintegration of the carbon burner was not caused by the electric current, but was due to "air washing," or the attrition produced by the passage of the air over the highly heated surface of the carbon.

As late as 1878, Mr. Sawyer, in a patent to Sawyer and Man, stated that no incandescent lamp had yet been devised which was practically operative, because of the defective methods employed for charging the lamp with artificial atmosphere which resulted in the disintegration of the carbon; second, because it was impossible under varying degrees of heat and pressure to maintain perfect joints; third, because of unequal expansion the carbon and its holder had resulted in fractures of the burner. But Edison overcame these obstacles, and produced a practical lamp. When we review the literature which preceded this invention, the subtle force with which it had to deal, whose laws had to be intelligently investigated and understood, the well nigh perfect workmanship necessary in construction, and the slow steps by which the end was finally reached, it seems on its face almost incredible that the incandescent lamp of Edison was in fact invented and operated by Henry Goebel in New York forty years ago, and publicly exhibited before hundreds of people.

Then follows a review of the Goebel affidavits, which our readers will find most fully given on page 78, Feb. 4, and on page 102. Feb. 11.

I have given the substance of the leading points of Goebel's affidavits because this case rests largely upon them. With respect to the age and history of lamp No. 4, it may be said that the evidence rests entirely upon his affidavits and that of his son, Henry Goebel, Jr.

The defendants produce some forty affidavits in confirmation of the statement of Goebel respecting his lamp. Of these witnesses, five are his children, one his niece and the remainder nearly all friends or acquaintances. So far as appears, these people are respectable and truthful. They testify generally to seeing the Goebel electric lamp in his shop and on his wagon containing the telescope at various times between 1850 and 1882, the time and the circumstances in many instances being given in detail, and some twenty witnesses identify the early fiddle-bow lamps as the same as those which they saw. Several witnesses also observed the lamp connected with the clock. To some, Goebel explained how the lamps were made, and several assisted him in their construction. Some declare the light was good, but do not state the length of time the lamp would burn. Generally speaking, the testimony is confined to the old fiddle-bow lamp, and relates to a period prior to or about 1860. A number of witnesses testify as to the good character, honesty and truthfulness of Henry Goebel.

It appears from the affidavit of Mr. Bull, an attorney at law, that Henry Goebel, Jr., delivered lamp No. 1 to him at his office in New York, Oct. 18, and lamp No. 2, Nov. 28, 1892, and that when received both the carbons were detached from the leading-in wires, and that he was then informed by Goebel that both the carbons were intact when he put the lamps in his pocket to bring them to his office. Henry Goebel, Jr., states that he delivered lamp No. 3 to Mr. Bull at the same time with No. 2, and that he broke the carbons in lamps 1 and 2 on the way to Mr. Bull's office.

From Mr. Williams' affidavit, it seems that gas was introduced in Monroe street in or about the year 1854; this, with the testimony of the elder Goebel and other witnessess, fixes the date of the construction of lamps 1, 2 and 3 as early as 1854.

Mr. Curtis, the counsel for the defendants in the New York cases, states that he first heard of Henry Goebel in the early part of 1882, and that in answer to his questions he said that he had made incandescent lamps like Edison's as early as about 1850. Owing to Geobel's imperfect English he had difficulty in understanding him. He gathered from the conversation that Goebel had not made any use of the lamps except for laboratory experiments, and that his work was not continued for more than a year or two after 1850. He asked him to produce some lamps, and he said he would look them up. His recollection is that he saw Goebel again, but that he had no further information to impart.

In the latter part of 1890, Mr. Bull, who had been counsel for the Consolidated Electric Company, informed him that Goebel's sons corroborated their father's statement, and that further additional evidence could be procured, but after consultation with General Duncan they concluded that the evidence was not sufficient to warrant an application to reopen their case to admit it. At the time of the injunction motion in the Sawyer-Man case in November. 1892, he made further inquiry in regard to Goebel, and was informed that some additional evidence had been obtained. Upon consultation with his associates, Mr. Wetmore and Mr. Root, it was concluded that the matter had not been sufficiently developed to present it as a defense in that case. Mr. Curtis goes on to state that, had he known of anything like the character and extent of the Goebel evidence as presented in this case, he should have regarded it of the greatest importance as constituting one of the best defenses in their case.

In further support of Goebel's anticipation, several experts give affidavits to the effect that the Goebel lamp, assuming that it was made prior to 1879, contains the broad invention covered by the second claim of the Edison patent, as it embodies the same combination of carbon filament with an all glass exhausted receiver and conductors passing through the glass.

Mr. Pope declares that Goebel lamps 1, 2 and 3 have a carbon filament within the meaning of the second claim of the Edison patent as defined by the Court, a receiver made entirely of glass and exhausted of air, and conductors passing through the glass, and all these elements combined for the purpose set forth in the patent; that these structures embodied the conception that carbon would stand high temperature, even when very attenuated, if operated in a high vacuum, without the phenomenon of disintegration.

He finds these particular lamps are not now in a condition to be operated, but he is satisfied that when first constructed they were capable of such operation, and had in fact been so operated. He knows of no reason why these lamps should not have been made long prior to 1879, and should not last as long and be as practically

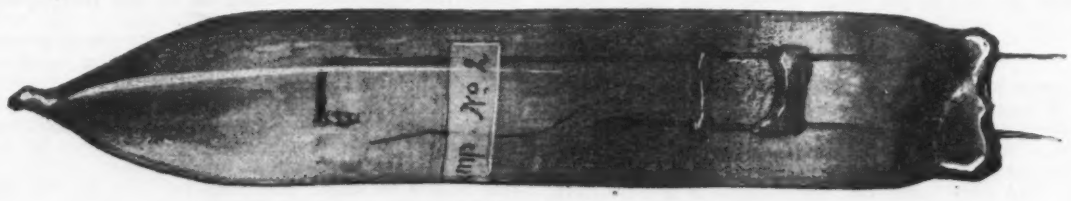


EXHIBIT 2.

useful as many forms of lamp described by Edison in his patent. He finds the leading-in wires in lamps 1 and 2 to be of iron, and in 3 of copper. In No. 3 he finds the leading-in wires are sealed by fusion into the lower end of the glass chamber, the glass being pressed around them when hot. The filament is made of carbonized woody fibre, apparently of bamboo or cane, and has a diameter approximately of eight to ten one-thousandths of an inch. The glass chamber is five inches long and seven-eighths of an inch in diameter, but is now cracked near the bottom, and consequently there is no vacuum.

Mr. Cross confirms these statements, and calls particular attention to the fact that the Goebel carbon is by reason of its diameter a "filament" as distinguished from a "rod," according to Prof. Barker's tables, and in the sense in which that term is used in the Edison patent as judicially construed.

In a second and supplementary affidavit, Mr. Pope says, with respect to the highly finished Goebel lamp No. 4, which has platinum leading-in wires and hair-pin shaped carbon, that at first he had doubts whether it was constructed as early as Goebel, and his son Henry, said, or prior to 1872. This arose from the circumstance that the joint between the carbon and copper wire appears to have been made in part by electroplating, and his experience led to the opinion that if the lamp had been first filled with mercury and then exhausted by inverting the tube, in one of the ways Goebel practiced, the

mercury would have united with the surface of deposited copper, and some traces of it remained, but as no such traces appeared visible in this lamp, he was led to believe that it must have been exhausted upon a vacuum pump. Upon questioning Goebel, however, he found that he had used chemically pure or distilled mercury. Afterward, Mr. Pope, by experiments, discovered that chemically pure mercury did not adhere to copper, nor leave any discoverable trace. This is the reason why this lamp was not before the Court at the arguments on this motion.

Mr. Pope is unable to get a current through this lamp because the circuit is somewhere broken. He sees no reason why it might not have been made before 1872. He is of opinion that it represents an advance over the prior Goebel lamps in details of construction and general workmanship, and that it is entirely capable, with the break repaired, of practical use as an incandescent lamp. He thinks it would burn without doubt three or four hundred hours, and that it clearly embodies the invention of the second claim of the Edison patent, as construed by the Court. He is also of opinion that iron leading-in wires are practicable in the construction of an incandescent lamp, and the next best thing to platinum. Mr. Cross, in a supplemental affidavit, confirms these statements. Mr. Cary, the electrician of the defendant company, states in an affidavit, that from experiments he has recently tried incandescent lamps capable of practical use can be made with iron leading-in wires.

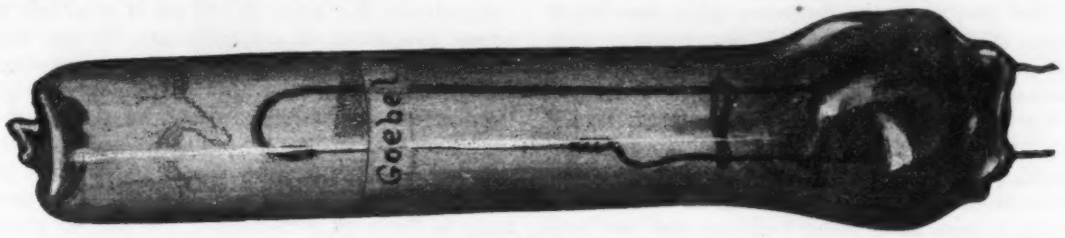


EXHIBIT 3.

There were filed, at the same time with the foregoing supplemental affidavits, other affidavits of persons who knew Goebel and saw his lamps. The light from the Goebel lamp seems to grow brighter and more steady as the affidavits multiply. For example, Mr. Voss, in his second affidavit, says: "Some of the larger lamps were attached in the store like gas fixtures. . . . . I have seen the store lighted with these electric lamps alone when the gas was turned off, and the light in the store was a nice brilliant light of, I should say, from eight to ten candle power to the lamp." Again, Mr. Hall states that the store was entirely lighted up by these lamps, which were brighter than gas jets; in fact, too bright, and that the light was very steady. Mrs. Stark says the lamps were brighter than an oil lamp or gas flame, and would burn an hour. George Pasbach, who married Goebel's niece, declares he could see to read by their light, and do fine work. Edward F. Mulligan says the lamps in the Monroe street store gave a nice bright light, whiter and much better than gas, and that you could easily read or do work by it.

To meet this alleged Goebel anticipation, the plaintiff introduces the prior adjudications upon the Edison patent, the affidavits of Edison and Barker relating to the history of the invention and the prior state of the art, and the affidavit of Upton shows that the defendant company was incorporated in 1890, and is now an active competitor in manufacturing and selling incandescent lamps. The plaintiff also produces the affidavit of Prof. Elihu Thomson to the effect that the Goebel lamps, like Exhibits 1, 2 and 3, could not have been useful for ordinary lighting purposes, and were never a practically operative light. One reason for this is, because the leading-in wires are of iron or copper, under which conditions a vacuum cannot be maintained, since the rate of expansion of iron and copper is very different from glass, the result being that the lamp begins to lose its vacuum as soon as it is heated and cooled. Another reason is that the leading-in wires are poorly and crudely sealed in, the glass work being thoroughly bad, and the lamps cracked and blackened on the ends by improper flame. While these lamps, in spite of leakage, might have been used for a short time, they could not have had a sufficient brilliancy for ordinary lighting purposes, nor possessed any commercial value. The vacuum not being maintained the heat would be carried away from the incandescent body by currents of gas, and this waste of energy robs the burner of its light-giving power. This statement, by Prof. Thomson, is agreed to and confirmed by the affidavits of John W. Howell and John E. Randall.

Prof. Thomson further says, that he remembers Henry Goebel as far back as 1881 or 1882, and that he visited his shop at that time, and that an endeavor was made to impress him with the value of the Goebel anticipation.

The plaintiff also, by permission of Court, filed affidavits after the arguments on the motion. These are important, not only as contradicting statements found in the affidavits of defendants, but for other reasons.

A number of these witnesses, who were neighbors or acquaintances of Goebel, or had other means of knowledge, deny that he exhibited any electric lights in connection with his telescope or in his shop, about 1860 or the years following.

There are the affidavits of John W. Howell and Frank Holzer, electricians, who corroborate the statement of Prof. Thomson that the Goebel lamps, 1, 2 and 3, were never practically operative by reason of a defective vacuum, and never possessed any commercial value.

Several witnesses state that Goebel spoke English well, and it is also proved that articles relating to the subject of incandescent lamps and Edison's inventions were printed during 1880, in the "Staats Zeitung," a German daily newspaper, published in New York.

But the more important evidence has reference to those persons who saw or dealt with Goebel, and who investigated his claim to have anticipated Edison in the art of incandescent lighting.

William C. Dreyer states that he undertook to form a company to purchase from Henry Goebel his inventions and patents, and that in 1882 he did procure from him an option for three months of all his inventions relating to electric lighting upon payment to him of $500, and an extension of the option for another three months, for which an additional $425 was paid. Goebel was also to have a large compensation from the company if formed. At that time, he said he had patented or applied for patents on a mercury pump, and a spiral holder for the carbon in an incandescent lamp. He said he had made small incandescent lamps called the fiddle-bow. It was considered of great importance to have one of these lamps, and he made every effort to find one, but never succeeded. The conversations with Goebel were carried on in German. The production of an old lamp was vital in this matter. During this time, negotiations with the Edison company were attempted through S. B. Eaton. The whole subject was gone over with E. N. Dickerson, the patent lawyer, who said that even if Goebel did what he claims, it was nothing but an abandoned experiment. The negotiations with the Edison company were in consequence dropped.

Albert Hetschel, a manufacturer of thermometers and scientific apparatus, states that in 1881 he was in the employ of the American Electric Light Company, and was directed to work with and help Henry Goebel, and was at his shop for several months. Hetschel describes how Goebel in a crude way made three or four little incandescent lamps with the use of a poor vacuum pump; that he was unable to make a successful lamp, and he is certain that if he had possessed at that time any incandescent lamps he would have shown them.

Otto A. Moses, a mining engineer, then in the service of the Edison company, visited Goebel in 1884. Goebel made some carbons for him. During this time, being much interested in the subject, he inquired of Goebel what he had done in the field of incandescent lamps. He examined all the lamps Goebel had and asked him to produce some of his old ones. Goebel requested permission to visit his laboratory and did so, and afterward solicited employment for himself and his son. Under these circumstances, he says it is improbable that Goebel at that time had any old meat-saw or hair-pin lamps in his possession.

Ludwig K. Bohm, an electrical expert, who was associated with Edison in 1879, and afterward in 1881 electrician of the American Electric Light Company, had several conversations with Goebel at the office of the company. At that time Edison's invention had been published in the English and German papers in New York. He conversed with Goebel in German on the subject of incandescent lighting, and he is certain that he would have mentioned his historical lamps if he had made them.

He then proceeds to discuss the lamps described in Goebel's affidavit, and declares that a vacuum sufficiently high to enable a filamentary carbon to last could not be made by filling the tube with mercury and then inverting it, because there is always air in the mercury, and that air also clings to the glass walls. In making standard barometers by the Torricellian vacuum it was found necessary to boil them out for hours in specially constructed apparatus. Further, owing to the specific gravity of mercury the filamentary carbon would be broken during the operation of filling and inverting the chamber. The lamps are likewise imperfect from the use of iron or copper leading-in wires, and no one of them shows any evidence that it ever contained a good vacuum.

William McMahon in 1880 was interested in starting a company to compete with the Edison lamp, and he and his associates, George Crosby and Edwin Fox, organized the American Electric Light Company in 1881. Crosby took him and his brother to Goebel's shop to talk over electrical matters. Goebel showed him an arc lamp, but said he had never made any incandescent lamps. He remembers also seeing some carbons and a vacuum pump which appeared like a swinging pump. Goebel's son was soon after employed by the American company. There was intense excitement at this time over the Edison incandescent lamp. Everybody recognized that Edison had made the invention. There was every reason at the time why Goebel and his son should have disclosed fully what they had done in this direction. If any one had preceded Edison in his invention, unlimited capital could have been secured for an opposition company. The American company wanted to make the Edison lamp, but did not dare to. For these reasons he is satisfied that Goebel never made an incandescent lamp prior to March, 1881. Thomas G. McMahon, his brother, confirms this story in his affidavit.

Sherburne B. Eaton, the legal adviser of the Edison company, states that in May, 1882, the law firm of Dickerson & Dickerson called his attention to the alleged inventions of Henry Goebel. They said that he claimed to have invented an incandescent lamp resembling the Edison. Goebel's representative in this matter was William C. Dreyer. No price was made, but we were asked to look into the matter. The subject was laid before the Executive Committee of the Edison company, and it was decided that Goebel had nothing worth buying. Mr. Dickerson's opinion was that if Goebel had made the inventions he claimed, they amounted to nothing more than abandoned experiment. On Nov. 28, 1882, Henry Goebel, Jr., called upon him, as representing the Edison company, and made another offer to sell the inventions and goodwill of his father, naming the price of $20,000, and the matter was again submitted to the company. On Dec. 12, 1882, he called again and was informed that the company did not wish to buy.

A patent was issued to Henry Goebel for an improvement in electric incandescent lamp, Oct. 24, 1882. This invention has reference to securing and cementing the carbon burner into flattened and spirally coiled ends of the conducting wires. The second claim, as drawn in the original application, was rejected by reference to the Edison patent, now in suit.

Upon consideration of the whole of the evidence on this motion I have reached the following conclusion:

It is extremely improbable that Henry Goebel constructed a practical incandescent lamp in 1854. This is manifest from the history of the art for the past fifty years, the electrical laws which since that time have been discovered as applicable to the incandescent lamp, the imperfect means which then existed for obtaining a vacuum, the high degree of skill necessary in the construction of all its parts, and the crude instruments with which Goebel worked.

Whether Goebel made the fiddle-bow lamps 1, 2 and 3 it is not necessary to determine. The weight of evidence on this motion is in the direction that he made these lamps or lamps similar in general appearance, though it is manifest that few, if any, of the many witnesses who saw the Goebel lamp could form an accurate judgment of the size of the filament or burner. But assuming they were made, they do not anticipate the invention of Edison. At most they were experimental toys used to advertise his telescope, or to flash a light upon his clock, or to attract customers to his shop. They were crudely constructed, and their life was brief. They could not be used for domestic purposes. They were in no proper sense the practical commercial lamp of Edison. The literature of the art is full of better lamps, all of which were held not to anticipate the Edison patent. The prior art demonstrates that to protect a carbon filament ten one-thousandths of an inch in diameter from speedy disintegration, the lamp chamber must maintain a nearly perfect and stable vacuum, and every part of the structure must be composed of such materials and so put together as not to imperil this vital condition. Leaving out other defects, it is abundantly shown that the Goebel lamp did not possess this requirement, and could not by reason of the elements which entered into its composition and the mode in which it was constructed. Goebel says he made more than a hundred lamps, and that a continual improvement took place in their construction, and yet the only three lamps produced at the hearing by his own confession were made as early as 1854, or before gas was introduced into his house. Where are the other lamps, which show these improvements except Exhibit 4, which I will deal with presently? The evidence of Goebel and his witnesses point to the conclusion that work ceased on these lamps in the "fifties," and was not revived until Edison twenty years later startled the electric world with his invention. Goebel brought from Germany the ideas contained in the old lamp of Starr, with its carbon pencil inclosed in a Torricellian vacuum, and he probably constructed some lamps after that pattern. In doing this he was up to and in line with the art as it existed at that early day, but to say that with a sudden bound he jumped from Starr to Edison passes the limits of credulity. The history of great inventions shows a gradual and labored progress. Each new investigator records some advance until it may be the desired discovery is almost within his grasp, but it is only after many attempts and many failures that some one appears who accomplishes the long sought for result. The discovery of the domestic incandescent lamp is no exception to this rule, as the record in the New York case bears witness. Speaking from the standpoint of the art of incandescent lighting in 1854 and in 1892 are two different things, and it is, therefore, quite easy for witnesses to think that Goebel did much more than there is any legitimate reason to suppose.

As for lamp No. 4, I cannot but view it with suspicion. It presents a new appearance. The reason given for not introducing it before the hearing is unsatisfactory. This lamp, to my mind, envelops with a cloud of distrust the whole Goebel story. It is simply impossible under the circumstances to believe that a lamp so constructed could have been made by Goebel before 1872. Nothing in the evidence warrants such a supposition, and other things show it to be untrue. This lamp has a carbon filament, platinum leading-in wires, a good vacuum, and is well sealed and highly finished. It is said that this lamp shows no traces of mercury in the bulb because the mercury was distilled, but Goebel says nothing about distilled mercury in his first affidavit, and twice he speaks of the particles of mercury clinging to the inside of the chamber, and that for this reason he constructed a Geissler pump after he moved to 468 Grand street, which was in 1877. Again, if this lamp has been in his possession since before 1872, as he and his son swear, why was it not shown to Mr. Crosby, of the American company, when he visited his shop in 1881, and was much interested in his lamps? Why was it not shown to Mr. Curtis, the leading counsel for the defendants in the New York cases, when he was asked to produce a lamp and promised to do so? Why did not his son take this lamp to Mr. Bull's office in 1892, when he took the old fiddle-bow lamps 1, 2 and 3? Why did not his son take this lamp to Mr. Eaton's office in 1882, when he tried to negotiate the sale of his father's inventions to the Edison company? A lamp so constructed and made

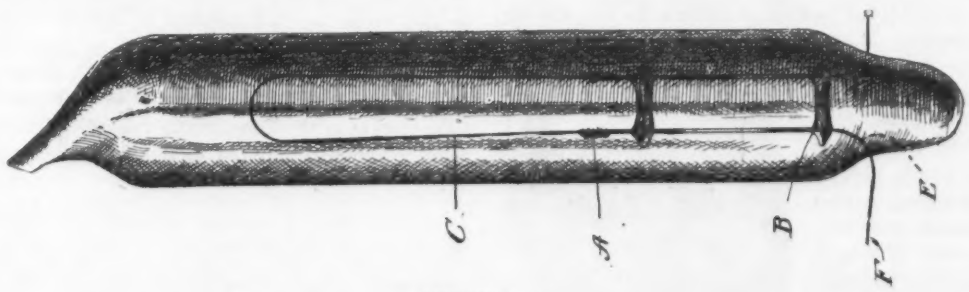


EXHIBIT 4.

before 1872 was worth a large sum of money to those interested in defeating the Edison patent like the American company, and Goebel was not a rich man. Both he and one of his sons were employed in 1881 by the American company. Why did he not show this lamp to McMahon when he called in the interests of the American company and talked over electrical matters? When Mr. Dreyer tried to organize a company in 1882, and procured an option from him of all his inventions relating to electric lighting, for which $925 was paid, and when an old lamp of this kind was of vital consequence and would have insured a fortune, why was it not forthcoming? Mr. Dreyer asked Goebel to produce an old lamp and was especially anxious to find one pending his negotiations with the Edison company for the sale of Goebel's invention. Why did he not produce this lamp in his interviews with Bohm, of the American company, or Moses, of the Edison company, when it was for his interest so to do? The value of such an anticipation of the Edison lamp was made known to him. He was desirous of realizing upon his inventions. He was proud of his incandescent lamps, and was pleased to talk about them with anybody who would listen. Is it conceivable, under all these circumstances, that he should have had this all-important lamp in his possession from 1872 to 1893, and yet no one have heard of it or seen it except his son? It cannot be said that ignorance of the English language offers an excuse. He knew English very well, although Bohm conversed with him in German. His children spoke English. Neither his ignorance nor his simplicity prevented him from taking out three patents, the first in 1865 for a hemmer, and the last in 1882 for an improvement in incandescent lamps. If he made lamp No. 4 previous to 1872, why was it not also patented?

There are other circumstances which throw doubt on this alleged Goebel anticipation. The suit against the United States Electric Lighting Company was brought in the Southern District of New York, in 1885. Large interests were at stake, and the main defence to the Edison patent was based upon prior inventions. This Goebel claim was then investigated by the leading counsel for the defence, Mr. Curtis. It was further inquired into in 1892, in the case against the Sawyer-Man company. It was brought to the attention and considered by the Edison company in 1882. It was at that time known to the American company, who hoped by this means to defeat the monopoly under the Edison patent. Dreyer tried to organize a company for its purchase. Young Goebel tried to sell it. It must have been known to hundreds of people. And now when the Edison company after years of litigation, leaving but a short time for the patent to run, have obtained a final adjudication establishing its validity, this claim is again resurrected to defeat the operation of the judgment so obtained. A Court of Equity should not look with favor on such a defence. Upon the evidence here presented, I agree with the first impressions of Mr. Curtis, and with the opinion of Mr. Dickerson that whatever Goebel did must be considered as an abandoned experiment.

It has often been laid down that a meritorious invention is not to be defeated by something which rests in speculation or experiment, or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy after an important invention has gone into public use for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long past. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome except upon the most clear and convincing proof.

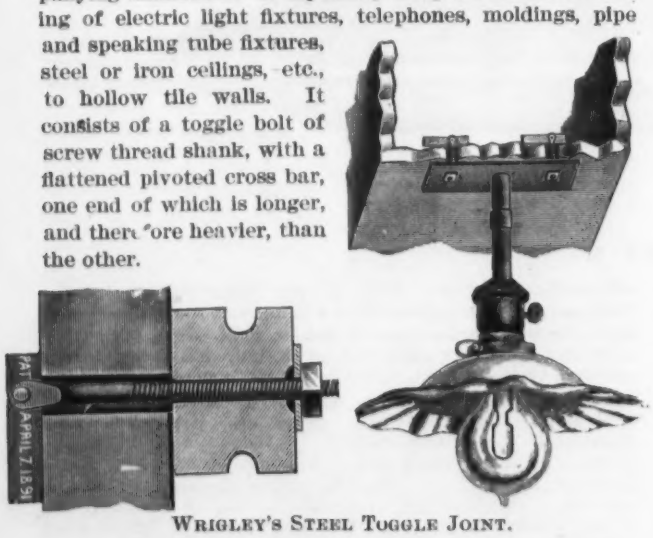
When the defendant company entered upon the manufacture of incandescent lamps in May, 1891, it well knew the consequences which must follow a favorable decision for the Edison company in the New York case.

Owing to the large interests involved, I have carefully considered this motion, and I am satisfied upon the evidence, and the law applicable thereto, that it should be granted.

Injunction granted.

Wrigley's Steel Toggle Joint.

The steel toggle joint which is shown in the accompanying illustration is especially adapted to the fastening of electric light fixtures, telephones, moldings, pipe and speaking tube fixtures, steel or iron ceilings, etc., to hollow tile walls. It consists of a toggle bolt of screw thread shank, with a flattened pivoted cross bar, one end of which is longer, and therefore heavier, than the other.



Wrigley's Steel Toggle Joint.

When a flattened cross bar is projected through a hole made for the purpose in the tiling or ceiling, the heavier end drops, thus securely fastening it in position. If too long, the end is clipped off with bolt clippers. The 3-16-inch size will sustain a weight of 200 pounds, while the 5-16-inch size will sustain 400 pounds.

The applications of this device are very numerous. It is manufactured in all sizes by the inventor, Thomas Wrigley, 85-87 Fifth avenue, Chicago, Ill.

The Maris & Beekley Hand Traveling Crane.

A hand traveling crane designed especially to meet the requirements of electric lighting stations where the comparative infrequency of its use precludes the employment of expensive power cranes has been brought out by Maris & Beekley, successors to the Maris Machine Company, of Philadelphia, and is shown in the accompanying cut.

THE MARIS & BEEKLEY HAND TRAVELING CRANE.

The general construction of the crane is as follows: Two steel I beams of proper section to give ample strength and prevent undue deflection when the load is in the centre of the span are bolted to separators at each end, and on the other side the truck brackets are secured—a wrought iron tie rod extending from the outside of the wheel bearing on one side under the beams to the outside of the wheel bearing on the opposite side—thus bringing the tensile strain on the wrought iron and the compression strain on the cast iron.

The truck wheels have roller bearings and are connected across the span of the bridge by a shaft carrying on each end a pinion which gears into and drives the truck wheels at each end, at the same rate of speed, causing the crane to travel straight on the runways. The hand wheel which operates this shaft can be placed at any point on the shaft desired.

The trolley runs on a track riveted on the upper flange of I beams and has roller bearing wheels driven by a hand wheel mounted in the trolley itself.

The well known Teal hoist is used, mounted in the trolley, and not hung below it, thus giving the greatest possible lift combined with a small amount of head room and forming a very compact and economical piece of apparatus, which will especially commend itself for use where the ceilings or girders are low and space is limited. Maris & Beekley manufacture this style of crane in sizes from 2,000 pounds capacity up.

The Priestman Engine.

In a recent letter before the Franklin Institute, Dr. Coleman Sellers presented some of the salient points of the Priestman engine, as manufactured in America. This engine was first brought out in England, where its marked success led to its introduction in this country. When Mr. Albert Priestman, of the firm of Priestman & Co., came to Philadelphia to introduce the engine in America, he fortunately secured as advisers such able men as Mr. W. P. Tatham, Mr. H. G. Morris, as well as Prof. Sweet, manufacturer of the well known Straight Line engine, who offered some valuable suggestions, which were afterward adopted in the Priestman engine.

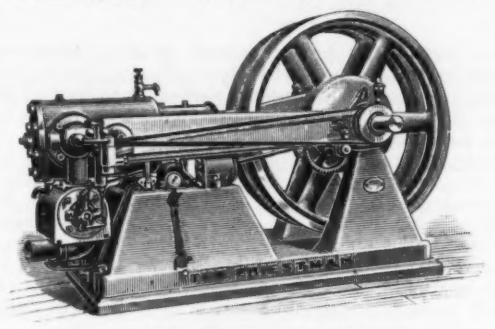


Fig. 1.—The Priestman Engine.

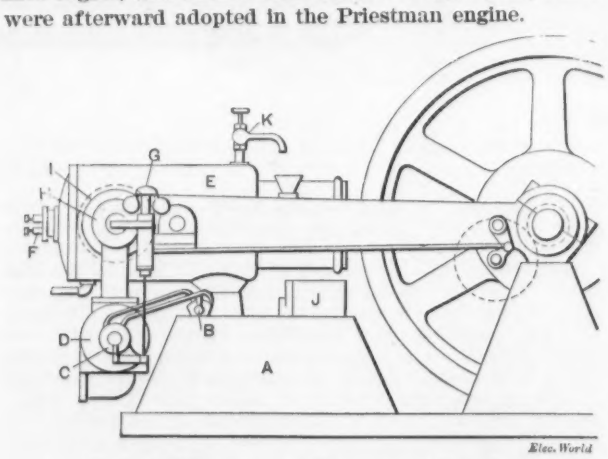


Fig. 2.—Details of Priestman Engine.

Prof. Unwin, in a paper on "Petroleum Engines," before the Institute of Electrical Engineers, London, gave the result of tests which he had made on the Priestman engine. He stated that this engine gave better results than a large triple condensing Sulzer engine, worked at high pressure. Dr. Sellers verified Prof. Unwin's figures by several tests under various conditions. In one case an engine yielding 8.25 brake horse power was run for two hours at full load under unfavorable conditions with an oil consumption amounting to 1.159 pounds per horse power hour, the oil costing less than five cents per gallon, or .09 of one cent per horse power hour.

The American design of the Priestman engine is shown in Fig. 1, while Fig. 2 gives a better idea of the system of operation. A is the oil tank filled with any ordinary high test (usually 150 degrees test) oil, from which oil under pressure is forced through a pipe to the three-way cock B and thence conveyed to the atomizer C, where it is met by a current of air, broken up into atoms and sprayed into the mixer D, where it is mixed with the proper proportion of supplementary air and sufficiently heated by the exhaust from the cylinder passing around that chamber. The mixture is then drawn by suction through the inlet valve into the cylinder E, where it is compressed by the piston and ignited by the electric spark passing between the points F of the ignition plug, the governor controlling the supply of oil and air proportionately to the work performed. The burned products are then discharged through the exhaust valve H, which is actuated by a cam. The inlet valve I is directly opposite the exhaust valve. The air pump J is used to maintain a small pressure in the oil tank to form the spray. K is the water jacket outlet.

In the largest engine only the 1-250th part of a pint of high test oil is used at any one time, and in the smallest size the fuel is prepared in quantities varying from 1-7000th of a pint upward, according as to whether the engine is running on light or full duty. It is seen that the engine is not only efficient, but there is absolute safety in regard to fire risks.

The engine is really not actuated by petroleum, but it is properly an air engine using petroleum as a fuel on the correct principle of the application of the heat with the least loss.

The Priestman engine is of the single acting bi-revolution type, ordinary in heat engines. One explosion takes place in each two revolutions of the crank. A charge of air and oil dust, moderately heated, is discharged into the engine during the forward motion of the piston; on the return stroke it is compressed to less than half its bulk, and explodes while the crank is on its dead centre. The spraying nozzle, as now used, pulverizes or tears up the oil into very small atoms, and at the same time protects the mouths of the passages from deposits of carbon.

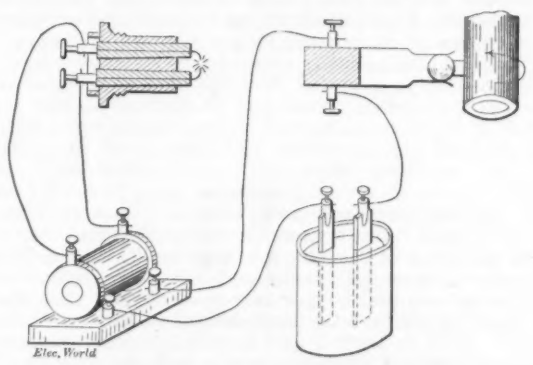


Fig. 3.—Ignition Device.

The regulation of the engine by a governor to effect the variation of power is accomplished by the varying of the oil supply, and not, as in most gas engines, by suppressing some of the explosions. The foundation plate forms only a support, but advantage is taken of the rear support by making it serve as a convenient oil tank for holding a supply for 15 or 20 hours. The cylinder and frame are cast in one piece, the cylinder being water jacketed, the arms hollow and of box section. The crank and fly wheel are exactly the same as in Straight Line steam engines, and are peculiarly well adapted for this class of engine. The connecting rod is a steel casting fitted with cast steel babbitted boxes. The inlet and exhaust valves are cast iron poppett valves with cast iron seats and steel stems. The exhaust valve is water jacketed. The mixer is a cast iron jacketed cylinder, around which the exhaust products are allowed to pass, keeping the inner temperature at a sufficient heat to prevent condensation of the oil dust.

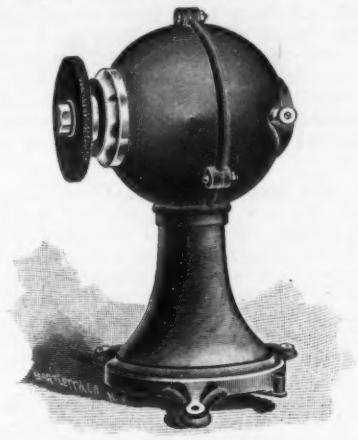
The ignition device, which is shown in Fig. 3, consists of either a primary or storage cell and induction coil. The primary wires are attached to the brass fork, the contact being made by a brass ball passing between the prongs at the proper moment. The secondary wires are connected to the ignition block, which is made of brass, the wires in passing through it being insulated by two pieces of porcelain and provided with platinum points between which the spark plays.

Practical experience has shown the Priestman engine to meet every requirement for which it has been de-

signed, and in all cases it has given excellent satisfaction. It is manufactured by Priestman & Co., 148-150 South Third street, Philadelphia, Pa.

An Emery Grinder.

The fact that the small as well as the larger sized Lundell power motors, manufactured by the Interior Conduit and Insulation Company, of New York, have been and can be adapted to many useful purposes, is again exemplified in the new beach emery grinder, which this company has just standardized. The accompanying cut illustrates this neat little machine, which will at once



EMERY GRINDER.

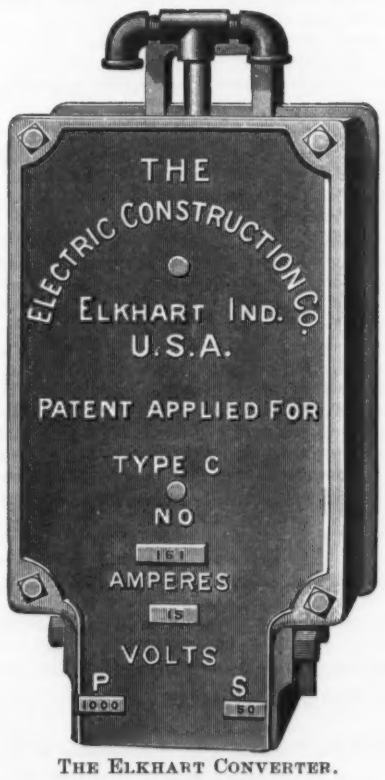
commend itself to machinists and others interested in the grinding of small tools, such as twist drills, lathe tools, engraving tools, knives, scissors, etc., etc. All shops that have adopted the electric illumination can most conveniently use this device. The emery grinder illustrated is 12 inches high, weighs 18 pounds, and operates at a speed of 2,500 revolutions maximum, and has in its base a regulating device for two lower speeds. It is of 1-6 h. p. capacity, 115 volts and swings a 2-inch emery wheel. Larger and smaller wheels driven by motors of higher or lower powers are also furnished by the Interior Conduit and Insulation Company.

The Elkhart Converter.

The Elkhart converter, which of late has been exciting considerable interest, is represented in the accompanying illustration. The best test for any kind of apparatus is that of hard, every day use, under all sorts of conditions, and it is claimed that this converter has proved equal to every occasion.

In construction the Elkhart converter is at once attractive, convenient and compact. The case, as is customary, is an iron waterproof shell, constructed with a view to the least possible weight consistent with the necessary strength.

Its special feature, however, is its electrical construc-



THE ELKHART CONVERTER.

tion. The coils are wound in an oblong coil extending the full length of the case, the secondary being first wound on a form and the primary wound over and upon the secondary. The iron is then built up inside and around the coils, the laminations being arranged in such a way that the joints are broken in every layer, that is, the joints do not come in the same place in any adjacent laminations. The result thus attained is that the coils are surrounded entirely by iron, making the converter almost a solid mass of iron, but at the same time broken up in a way that effectively prevents the action known as hysteresis, which causes heating and magnetic loss.

The Elkhart converters are being exploited in the West by the Electric Appliance Company, of Chicago.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Feb. 17, 1893.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

The market for the week under review is a fulfillment of our prophesies of the past few weeks. On Monday Secretary of the Treasury Foster visited New York to feel the pulse of this financial centre, relative to the advisability of issuing bonds to bolster up the Treasury gold reserve. He met with an almost universal sentiment in favor of a bond issue. Upon his return to Washington it was given out that the Cabinet had refused to recommend a bond issue and the selling of stocks started. It reached its height to day and values a corresponding depth. So firmly had the pessimistic sentiment engrafted itself in Wall street that when the news came that Secretary Foster had been given authority to issue bonds at his discretion, it had little or no effect. The decline brought a demand from the banks for additional security on stock collateral. This augmented the downward movement. The bears made the most of their opportunity, selling stocks right and left. The industrials, especially Cordage, Sugar and Lead, and the Coalers, notably Reading, were their especial objects of attack. Values sold off first by fractions, and then by points. It was not until later in the day that the movement was checked. The situation at the close was most uncertain, and may turn into either a bull or a bear market, according to the course of current events. If the Treasury should decide to issue bonds, which hardly seems probable, owing to the short time in which the present administration holds the power, or should some tangible action be taken toward repealing the Sherman silver law, confidence would, in a measure, be restored. In case no action is taken along either of these lines gold exports will continue. This in turn will make money tighter and may result in precipitating a panic. To say the least, the situation is most serious, and cannot fail to impress upon Congress the necessity of speedy action. Money at the close to-night was four per cent., and very firm. The belief prevails that it will go much higher.

NEW YORK ELECTRICAL STOCK MARKET.

The course of this list of specialties was controlled by the general market conditions almost absolutely. The decline that took place in the various securities can be said, with hardly an exception, to have resulted from these causes. It is a noteworthy fact that this decline, compared with the other industrials, was slight, and leads to the belief that the electrical stocks possess a stability not possible for the more active contemporaries This panicky condition of affairs naturally placed a damper on all trading in the less active of the electricals. To quote one broker: "It is almost impossible to create an interest in these stocks. With a revival of confidence we expect to make up for lost time."

Western Union.—Western Union showed considerable strength in the face of the general downward tendency up to to-day, when it broke to 95½. No particular cause is ascribed except those set forth preceding. On Monday a block of bonds amounting to $130,000 sold at 105. On subsequent sales the price dropped to 104¾.

General Electric.—General Electric held its own firm up to to-day, when it weakened perceptibly, its range being 107¼ to 109, 108¾ being the closing. It was quite evident to the traders early in the day that considerable long stock was coming on. Inquiry verified the fact that an estate which was being wound up was supplying this stock. As near as can be learned the liquidation is about over. In which case, general conditions being favorable, we look for a rally. The five per cent. bonds were offered on the downward scale, going from 100¾ of last week to 99⅛. The avidity with which they were taken in the face of the weak market showed unmistakably the degree of favor in which they are held by investors. Mr. Coffin, president of the General Electric Company, according to a contemporary denies the rumor that he is to resign his office to take the presidency of the New England Street Railway Company.

Westinghouse.—This company will pay interest on its scrip up to March 1 to holders of record on that date. Books close Feb. 24 and open March 2.

The Western Telephone Construction Company.—This company, of Chicago, has been granted permission to form an corporation. It claims to own 30 patents rivaling those now in use.

New England Street Railway Company.—A corporation of the first magnitude as regards wealth, powers and possible scope, and one of special interest to trunk-line railways running between New York and Boston, was formed Thursday by a Boston syndicate, when a certificate of incorporation of the New England Street Railway Company was filed in the office of the Secretary of State of New Jersey at Trenton. The capital stock is $5,000,000, with the privilege of increase to $50,000,000. The directors of this company, which has a modest name compared with the powers it has acquired in its charter, are John R. Bullard, president of the Dedham (Mass.) Savings Bank and the Dedham National Bank; James C. Elmo, president of the Shoe and Leather National Bank of Boston; Col. John H. Cunningham, president of the Winnisimmet National Bank, of Chelsea, Mass.; W. B. Ferguson, president of the Gloucester Street Railway Company, Gloucester, Mass.; William H. Leonard, vice-president of the North National Bank, of Boston. Dr. A. F. Mason, described as a "capitalist"; Major A. C. Pond, president of the New Haven & West Haven Street Railway Company; A. R. Mitchell, vice-president of the New England Trust Company, of Boston; Thomas T. Robinson, Treasurer of the West Leicester & Spencer Street Railway Company, of Boston, and James Brooks Dill, of Dill, Chandler & Seymour, of 31 Nassau street, New York, who are the counsel for the new company. All of these men are widely known as New England financiers, and many of them have identical interests with those of New England trunk line railways. The general scheme of the company, so far as it can be learned, is to effect a consolidation of all the street railways in New England as a starter, and then proceed to amplify the system so as to connect all the smaller towns by these railways, which will thus relieve the trunk lines of much of the local travel. The control of the New England Street Railway Company will accordingly be of considerable interest to these various trunk lines, and the new company is believed to be practically a local branch of the other service, which will now be able to handle its through passengers to better advantage. The charter of the new company is broader even than the celebrated charter of the North American Company, which was also obtained in New Jersey. The New England Street Railway Company can embark in any business whatever, and almost anywhere it chooses. It is also announced that the company proposes to carry on business in every State in the Union and in every Territory, and in such States and Territories as may hereafter be created or admitted. Besides these places, the company also proposes to do business "in Montreal and all other places in Canada, Buenos Ayres, and all other places in the Argentine Republic, London, and all other places in Great Britain and Ireland, and in Paris and all other places in the Republic of France."

The Edison Electric Illuminating Company, of New York.—This company's stock sold down upon small realizations by fractional points during the week, reaching 124. There was fair support rendered in the form of purchases whenever the stock was offered. The bonds were in some demand at about 122. The company makes an excellent showing for January. This compared with other years is as follows:

	1893.	1892.	1891.
Gross earnings	$120 230	$87,704	$58,188
Operating and general expenses, including taxes	54,030	40,936	27,211
Net earnings	66,200	46,767	30,977
Accrued interest on bonds	13,208	9,375	8,333
Incandescent lamps, end of Jan.	146,871	97,659	66,278
Arc lamps, end of January	1,694	885	256
Motors, h. p., end of January	3 891	2,092	744

The total installation exceeds an equivalent of 202,000 16-c. p. lamps.

Closing Quotations.—The following were the closing quotations of electric stocks on Friday, Feb 17, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel.	100	3,825,000	...	...	....	....
American Tel. & Cable	100	14,000,000	....	90	90	90½
Central & So. Am. Tel.	100	6,500,000	....	...	110	117
Commercial Cables	100	7,716,000	....	....	170	185
Gold Stock & Tel	100	5,000,000	....	....	100	103
Bonds	500	500,000	....	....	....	....
Franklin	100	1,000,000	....	....	35	40
Mexican Telegraph	....	2,000,000	....	....	180	200
Metropolitan Tel. & Telegraph Co	....	....	....	....	102	....
Northwestern Telegraph	....	2 500,000	....	....	102	105
Northwestern Tel 7's	....	.....	....	....	108½	....
Postal Tel. & Cable	...	10,000,000	....	....	81½	82½
Southern & Atlantic Tel	25	948,775	....	....	78	80
Western Union Tel.	100	94,820,000	96	98	96¼	96¾
Real estate bonds	1,000	1,219,000	....	....	....	....
Debenture 7's, 1873-1900	1,000	1,920,000	....	....	....	....
Collateral Trust 5's	1,000	8,181,000	104¾	105	104¾	105
North American	100	39,767,200	10½	9⅞	9½	10
Brush Ill. Co. of N.	50	1,000,000	....	...	25	30
Edison El. Il. of N. Y.	100	6,100,000	124	126½	124½	124⅞
" " 1sts	...	... .	122	122	...	....
" " Deb's	...	.....	....	....	...	....
Edison El Il. of Brooklyn.	100	1,500,000	...	....	115	120
" " " " Chicago	100	750,000	....	....	170	180
" " " " Boston	...	.....	....	....	130	140
" " " " Philadelphia	...	.....	....	....	130	131
Edison El. Lt. Europe	1,000	2,000,000	....	....	2	6
" Bonds	....	30,000	....	....	80	85
Edison Ore Milling Co	...	2,000,000	....	....	12	17
East River El. Light	100	1,000,000	....	....	....	65
Fort Wayne Electric	...	.....	....	....	13	13¼
General Electric	1,000	30,395,600	110⅜	107¼	108¼	108¾
Debenture 5's	...	10,000,000	99½	100	99½	99½
Automatic Exhibition Co.	...	2,500,000	..	....	3	5
Interior Conduit & Ins. Co.	100	1,250,000	....	....	66	68
Mt. Morris Electric	...	500,000	....	....	...	65
N. E. Phonograph	....	2,000,000	....	....	2	4
N. Y. Phonograph	....	2,000,000	....	....	2	5
N. American Phonograph	..	2,000,000	....	....	4½	6
Westinghouse E. & M. Co. 1st p. 7 per cent., Cum.	50	3,755,700	....	....	....	....
E. & M. Co. Assg	50	5,333,940	....	....	....	....

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago	190	194	Chicago Arc Light and Power Co	117½	118
Central Union	....	54½	Chicago Edison Co	220	....
Michigan	....	93			

NEW INCORPORATIONS.

The Bradsborough Street Railway, Wilkes-Barre, Pa., capital stock $12,000, has been formed to construct and operate an electric railway. The organizers are H. G. Kulp, G. Mortimer and W. K. Stevens.

The Conshohocken Railway Company, of Conshohocken, Pa., capital stock $100,000, has been formed to construct and operate an electric railway. D. B. Shepp, Jos. Fornance and J. D. Corson are the promoters.

Fairbury Electric Light, Heat and Power Company, of Fairbury, Ill., capital stock $12,000, has been incorporated to furnish electric light, heat and power. H. A. Foster, N. J. Foster and C. E. Grandy are the promoters.

The Cleburne Light, Ice and Oil Company, Cleburne, Tex., capital stock $75,000, has been formed to supply electric power, etc. The promoters are P. C. Chambers, J. W. Floore, J. D. Osborne and J. B. Joiner, all of Cleburne.

The Austin Engineering Company, of Chicago, Ill., capital stock $100,000, has been formed to build, operate and superintend steam and electric plants. E. F. Austin, D. W. Dunn and Joshua L. Clark are the promoters.

Merion Avenue Passenger Railway Company, Philadelphia, Pa., capital stock $50,000, has been organized to construct and operate an electric railway in Philadelphia. The promoters are F. S. Harrison, Wm. L. Kite and J. Clayton Erb.

The Bristol & Trenton Passenger Railway Company, of Bristol, Pa., capital stock $18,000, has been formed to construct and operate an electric railway. H. V. Massey, F. G. Edwards and Wm. V. Massey are the promoters.

The Belmont Avenue Railway Company, of Philadelphia, Pa., capital stock $18,000, has been formed to construct and operate an electric railway in Philadelphia. D. E. Williams, J. S. Gerhard and G. Bronton Roberts are the incorporators.

The Auburn Electric Motor Company, of Auburn, Me., capital stock $50,000, has been formed to manufacture and deal in electrical apparatus of all kinds. C. H. Lucas, Walter F. Brown and Harry G. Davis, of Auburn, Me., are the promoters.

The Hampton Electric Light and Power Company, of Hampton, Ia., capital stock $20,000, has been formed to furnish electric light and power. S. F. Farnham, Charles City, Ia.; E. Buck, Hampton, Ia., and H. W. Turner are the parties interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Feb. 20, 1893.

The American Institute of Electrical Engineers will hold its seventy-fourth meeting at the headquarters of the Institute, 12 West Thirty-first street, on Tuesday, Feb. 21, at 8 P. M. The following papers will be presented: "Note on the Disruptive Strength of Dielectrics," by Chas. P. Steinmetz, Yonkers, N. Y.; "The Most Economical Age of Incandescent Lamps," by Carl Hering, Philadelphia.

The National India Rubber Company, Bristol, R. I., has decided to open an agency for the sale of its well known N. I. R. wire in New York City. This company has had 20 years' experience in the manufacture of insulated wires and cables, which have been passed upon and approved by the Board of Fire Underwriters of New York, Boston and Chicago. The New York City office, which is at 487 Broadway, is under the charge of Mr. H. L. Burdick, whose experience and abilities especially qualify him for this work.

A New Traction Company Formed.—The New York Traction Company, which, it is supposed, will be a rival to the Metropolitan Traction Company, was incorporated at Albany on Thursday for the purpose of constructing railroads and furnishing power for railroads in this city. The directors are John A. McCall, F. K. Hain, T. D. Jordan, W. H. McIntyre and George V. Turner, of this city; Charles A. Johnson, Raymond C. Johnson, Charles H. Russell and Charles Curie, of Brooklyn, and James A. Morriss and F. C. Van Dyke, of Paterson, N. J. It is said that Charles H. Russell is the prime mover in the enterprise, a member of the company, and also its legal adviser. President McCall declared that the company has nothing to do with the elevated road or with the present Metropolitan Traction Company. "It concerns one electric surface road in New Jersey and two horse railroads in this city," he added. "The electric road is in Paterson, N. J., and consists of the Grand Street, Paterson, Central and Little Falls branches. The two horse railroads in question noted the success of the Paterson electric street railway, and made overtures looking toward their purchase by it. The directors of the Paterson road desired to accept the offer of these two horse railroads, but found that their charter would not permit them to make the purchase. For this reason it was decided to organize the New York Traction Company, which should have the power to buy both the Paterson road and the two horse railroads; the smallness of the capital, which is only $5,500, is on account of the tax laws. It is our intention to ask the officials of Bergen county to grant us a franchise for laying a double-track trolley road from Paterson to the Hackensack River and across the Secaucus bridge into Hudson and Hoboken counties, the authorities of which will then be asked to permit the extension of the road to the Hoboken ferry on the Hudson River. Something like fifty miles of track will be laid at an estimated cost of about $500,000 If we succeed in buying the two horse railroads we shall equip them with the trolley. We do not intend to extend our purchases beyond the two roads in question."

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Feb. 18, 1893.

The F. E. Belden Mica Mining Company, on account of increased business and the necessity for more room and better facilities, has moved to 12 Broad street, near State street, Boston, Mass.

A new electric company has recently been organized in Concord, N. H. under the name of the Granite State Electric Company, with a capital of $30,000, for the purpose of manufacturing electric machinery, etc

Mr. A. D. Newton, treasurer of the Eddy Electric Manufacturing Company, of Windsor, Conn., in company with Mr. M. E. Baird, general manager of the same company, were in Boston last Wednesday, visiting the Boston office.

The Manet Street Railway has been bought by the Quincy & Boston Street Railway Company. It is a four mile electric road connecting Quincy Center with Hough's Neck and Manet Beach' the summer resort. The Quincy company paid $100 a share for 400 shares, the par value. But 50 more shares are outstanding, and the Quincy company has purchased 25 of these. The Manet has never paid a dividend, although it has earned five per cent., which has been used in construction.

The Tripp metallic packing is meeting with marked success in its line of business orders recently being received to supply packing for the large engines at the power houses of the Lynn & Boston Railway, one located at Lynn and the other at Chelsea, Mass., and also the engines of the Union Railway, Atlantic Avenue Railway, and the Brooklyn City Railroad, of Brooklyn, N. Y. It is now in use both in Cambridge and Boston on the West End Railway. Messrs. Wm. B. Merrill & Co. have recently become the sole manufacturers. The office and salesroom are located at 620 Atlantic avenue, Boston, Mass.

WASHINGTON NOTES.

WASHINGTON, D. C., Feb. 18, 1893.

A consolidation of the affairs of the Rock Creek Railway Company and the Chevy Chase Land Company was recently brought about, and the corporation is now known under the last named title. Surveys have been made from the present country terminus of their electric road to Kensington, Md., some two miles distant, to which point it is contemplated building.

The Washington & Arlington Railway.—After a long and weary war for the use of the piers of the Aqueduct Bridge to enable it to enter the city, the bill granting the Washington & Arlington Railway the privilege has been finally passed by Congress. The work will be pushed so as to be completed by Decoration Day, at which time many thousands of people visit the National Cemetery at Arlington.

Storage Battery Cars Pronounced a Failure.—The bill allowing the Eckington & Soldiers' Home Railway Company to use horse power upon its lines awaits the signature of the President. The road asked for the relief on account of the failure of the storage system on the G street line. The officers say that it is expensive and incompetent, and the weight of the cars is ruining its roadbed. It is probable, however, that the horse power will only be used on the Capitol Hill extension, as the company will use the trolley where allowed.

Possible Introduction of the Trolley System.—Since the immense deals in street railway stocks have occurred, there has been no end of street railway talk. The possibility of a powerful syndicate having secured control of the Belt, Columbia and Metropolitan lines has created considerable stir as to their probable effort to secure legislation that would allow them the privilege of operating by means of the overhead trolley system. While it is quite probable that such a bill would pass the House, it is stated with all assurance that it would certainly be killed in the Senate.

Big Street Railway Deal.—For some time past transfers of railway stocks has been frequent and of such magnitude that it is now rumored that a Philadelphia syndicate have secured control of several different lines. The roads involved are the Belt, Columbia and Metropolitan lines, and it is as yet uncertain as to whether the purchases have been made for the Widener-Elkins syndicate of Philadelphia, or in the interest of the Washington & Georgetown Cable Road. It would not be strange if the last named corporation should endeavor to secure control of these lines in order to prevent the possible transfer to a more powerful syndicate.

The Budapest System To Be Introduced in Washington.—The Columbia Street Railway Company has decided to abolish horses and adopt electricity, the system being the one so successfully operated in Budapest. For more than a year this company has been in search of a suitable motive power, and it finally reached the conclusion that this was, all things considered, the best. Contract for the installation has been made with the owners of the system, the Siemens & Halske Electric Company of America, who have, during the past year, been making preparations for an extensive business in this country. Construction is to be begun about June 1, and it is expected that the line will be in operation by Oct. 1 of this year.

The Gridiron Club Banquet.—The annual banquet of this now famous club was held on the evening of Feb. 3, and, as usual, was an exceedingly interesting affair. The decorations were worthy of the event and the electrical effects were extremely novel, constituting one of the most effective surprises presented during the evening. The immense electrical gridiron over the president's chair was four feet square, and sparkled and scintillated with the glow of hundreds of white globes. Nestled in the masses of green, with which the table was spread, were other miniature lights, like fairy blossoms, that bloomed or faded at the will of the president, who had at his command an electrical switchboard which controlled the entire display. These electrical features were the design of Mr. L. K. Bliss, general manager of the Bliss Engineering Company.

The Washington & Mount Vernon Electric Railway.—The bill to authorize this company to build and maintain a bridge across the Potomac River has been favorably reported upon, as amended. The route as now proposed is from a point where New York avenue crosses the lower portion of Observatory Hill, thence along New York avenue to C street, along C street to Virginia avenue, to B street, along B street to Fifteenth street, and along the last named to the south side of Pennsylvania avenue, opposite the Hotel Randall. Also from said bridge along New York avenue to Seventeenth street, and along Seventeenth street to the south side of Pennsylvania avenue, opposite the War Department. All wires must be placed underground. This road, which is already in full operation between Alexandria, Va., and Mount Vernon, is preparing to extend its line beyond the last named place, and will establish way stations for the reception of freight and passengers. The Woodlawn section is made up of dairy and garden farms, the produce of which will, in the near future, be shipped by the electric road.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Feb. 18, 1893.

The Electric Appliance Company reports a lively and growing demand for its adjustable electrolier. It states that, judging from the way the orders come in, it will almost entirely displace the old style cord adjusters.

The Rhiele Bros. Testing Machine Company announce that beginning April 1 Mr. J. R. Matlack, Jr., will act as its representative at the World's Columbian Exposition, Chicago, and can be found, previous to the opening of the Exposition, at the office of R. W. Hunt & Co., Rookery, Chicago.

The Detroit Electrical Works, Detroit, Mich., has issued a circular announcing the appointment of Mr. L. E. Myers as district manager of the company, with offices at 917 and 918 Monadnock Building, Chicago. The list of this company's manufactures comprises the well known Detroit electric railway power and lighting machinery, as well as many lines of general electrical supplies of the highest grade.

CLEVELAND, O., Feb. 18, 1893.

A scheme is on foot in the council for bonding the city to the extent of $500,000 for a municipal electric lighting plant.

The Superior Machine Company, of Cleveland, has been formed for the manufacture of electrical apparatus, supplies and repair parts.

The contract for the equipment of the Wooster Electric Road has been awarded to the Central Electric Company of Cleveland and Cincinnati.

Judge Logue has decided that conductors on street railways must carry tickets, and, in case they are unprovided, cannot collect fares when tickets are demanded.

The Hill Clutch Works, Cleveland, O., will be represented at the St. Louis convention by Messrs. Hill and Leonard, both of whom are well known in the electrical field.

The Ohio Construction Company, Cleveland, O. of which Mr. C. W. Wason, is president; B. M. Barr, vice-president; H. L. Browning, general manager, and G. E. Donald, superintendent, has opened its office at 54 Frankfort street.

E. P. Roberts & Company, of Cleveland, O., consulting electrical and mechanical engineers, are very busy at present. They now represent Bristol's recording pressure gauge, as well as other indicating and regulating apparatus.

Damage suits aggregating $175,000 have grown out of a recent accident on the Collimer line of the East Cleveland Railway Company. The trouble was occasioned by a Collimer motor running into a sleigh. Several people were injured seriously, but none fatally.

Director of Law Meyer has reported in connection with the ordinance for according a franchise for the construction of a cross town road, that this ordinance must be advertised for three weeks before passage, and upon its passage the franchise must go to the company bidding to carry passengers at the lowest rate.

The right of way for the proposed east and west road from Lindale to Gordon Park is being rapidly and energetically sought for. Mr. G. F. Scofield is at the head of this project. Quite a good deal of frontage has been obtained already, but the scheme is meeting with considerable opposition, principally from the Brooklyn Railway Company, which wishes part of the route for their own lines.

The first meeting of the stockholders of the Cuyahoga Electrical Company for the purpose of electing officers was held at the Hollenden Hotel. The following were chosen: W. G. Marshall, superintendent; N. S. Armstrong, secretary, treasurer and superintendent; directors: C. E. Ferrell, George S. Sowden and W. R. Coffin. The company has obtained a contract for the lighting and furnishing of power for West Cleveland village, and will soon have a plant.

Mr. J. Potter, who has been for many years treasurer of the Brush Electric Company and is president of the Short Electric Railway Company, has resigned these offices to take effect at the convenience of the companies. Mr. Potter graduated from Princeton College in 1877. In 1881 he decided to engage in the electrical industries and made an engagement with the Brush Electric Company to take charge of its business in China and Japan, and was the pioneer of electric lighting in these fields. He resided for a number of years in Yokohama and made large contracts for Brush apparatus with the Chinese and Japanese governments, and established the first electric lighting stations in the Orient. In 1884 he returned to Cleveland to take the positions of a director and treasurer of the Brush company. It is understood that Mr. Potter will devote himself entirely to his private business interests.

The Board of Directors of the East Cleveland road, at a recent meeting, decided upon a reduction of fares as follows: Six tickets to be sold for 25 cents, and 25 tickets for $1.00. This reduction will go in force as soon as the new tickets can be gotten out. At the same meeting it was decided to distribute among the employés of the road $7,000 yearly in the form of prizes to the most efficient conductors and motormen. This sum will be divided and awarded as follows: First. The award will be semi-annual, and will consist of ten first prizes of $50 each to be given to motormen making the largest number of miles free from all accidents and in accordance with the rules of the company, provided that no man be permitted to share in such prizes who does not report each and every accident seen by him while running on the road. Second. Ten first prizes of $50 each to be given to conductors under the same conditions. Third. Ten second prizes of $25 each to be given to the motormen and ten second prizes of $25 each given to conductors under the same conditions as the first prizes. The prizes are to be awarded by a board consisting of one man nominated by the company, one nominated by the employés and one chosen by the other two. The company has also decided to purchase immediately 20 new motor cars.

Plans for new electric roads in Cleveland are multiplying rapidly. There are now five such schemes in a more or less advanced state, besides the electrical equipment of the St. Clair line. Mr. A. L. Johnson's proposal for a road running through the square to Gordon Park and thence across town was mentioned in THE ELECTRICAL WORLD recently, and it now appears that the other parties who were then discovered to be in the field are Messrs. L. A. Russell, Sidney H. Short and J. Potter, of Cleveland, and Herbert Payson, of Portland, Me. These gentlemen have asked for a franchise to run a road over very much the same territory as that desired by Mr. Johnson. Their proposition was referred by the council to the Board of Control and the Committee on Streets and Railways. In addition to this, an east and west line is proposed, beginning at Lindale on the west, running through Brooklyn village to the viaduct, through the Square, and finally reaching Gordon Park on the east. It is also reported that the Ford & Washburn Storelectric Company will renew their efforts to obtain a franchise for a cross-town road on Wilson avenue, from the lake to Broadway. It is also expected that a suburban line will be built from Berea to the terminus of the Woodland avenue and West Side roads, Detroit Street line, this coming season.

DETROIT, Mich., Feb. 18, 1893.

Mr. A. A. Robinson, manager Detroit Motor Company, will attend the St. Louis convention.

The Detroit Motor Company is still pushing its business successfully. Mr. A. A. Robinson, manager, has just returned from Omaha, where he captured a cash $1,200 sale. It has also just shipped three 10-h. p. motors and two 2-h. p. motors to the New York *Herald*.

The Electrical Carbon Company, Detroit, Mich., has shipped 8,000 carbon batteries the past thirty days, and has orders for 5,000 more.

The Detroit Dynamo Company, Detroit, Mich., now do all the work for the Michigan Auxiliary Fire Alarm Company for repairs and new equipments in conjunction with their dynamo business.

The Detroit & Belle Isle Electric Navigation Company has been organized for the purpose of operating a regular ferry and transportation line of electric launches between the Belle Isle bridge approach at Detroit, Mich., and Belle Isle, and also a connecting line through South Canal into the river on the Canadian side and back again to the American side.

Mayor Pingree, of Detroit, Mich., has taken in hand to compel the Citizens' Street Railway Company to sell on the cars workingmen's tickets at 25 cents for eight tickets. This the company refuses to do on the street cars, as it is inconvenient for the conductors, preferring to sell them only at designated stores in different locations in the city. The result has been several men have offered to buy on the cars and, being refused, were put off the cars, and will make a test case, suit having been filed in Court for the same.

The Citizens' Committee, with Mayor Pingree, of Detroit, will start on a trip visiting at once Chicago, Washington, D. C.; Pittsburgh, Philadelphia, New York and Boston to investigate the electric lighting interests in these cities in furtherance of establishing an electric light plant for city lighting in Detroit, Mich. The Detroit Electric Light Company, which now has the contract for lighting the city, is anxious the city should buy its plant with the towers and appliances now up. A bill is pending before the House at Lansing to grant the city of Detroit the right to build, run and establish its own electric light plant, and an amendment has been urged that the city shall buy the plant of the Detroit Electric Light Company at about half a million dollars. This Mayor Pingree refuses to do and prefers to make a tour of inspection of electric lighting plants, after which terms may be satisfactorily arranged it is thought. Otherwise, competitors will be asked to bid on a new plant at once. There is now a double set of electric light towers up, the result of two companies having secured lighting contracts

News of the Week.

THE ELECTRIC LIGHT.

Ida Grove, Ia., has decided in favor of electric lights.

Minot, N. Dak., is considering the question of electric lighting.

Fulda, Minn., will soon have electric lights and water works.

Lansing, Mich.—Superintendent Fitzgerald, of the Peninsula Electric Light Company, is anxious to sell the company's plant to the city.

The Kansas City Electrical Works has applied for a franchise permitting the erection and maintenance of poles and wires, and the construction of an electric light plant in the district south of Kansas City to Forty-third street, and east of Westport to Prospect avenue.

The Silvey Storage Battery, manufactured by the Dayton Manufacturing Company, of Dayton, O., has been used for more than a year to light trains on the Chesapeake & Ohio Railroad. Forty cars are equipped with 24 cells each. The batteries are stored at Covington and run from Cincinnati to Jersey City and back without recharging. Since the cars began running it is said that there has not been a short circuit on any of them. The F. F. V. train on the same road is also soon to be lighted by the Silvey system. A train on the A., T. & S. F. is also to be lighted by the same system.

THE ELECTRIC RAILWAY.

The Danbury (Conn.) City Council voted on Feb. 9 to reject the resolution favoring the trolley.

The Highland Park electric road, of Detroit, Mich., has been transferred from the Detroit Suburban Street Railway Company to the Detroit Citizens' Street Railway Company. The purchase price was $150,000.

The Woonsocket (R. I.) City Council has granted a twenty years' franchise to the Woonsocket Street Railway Company, which expects to have in operation during the coming summer more than 25 miles of street and suburban electric railways.

Taxes on Street Railways.—The warfare between Mayor Boody, of Brooklyn, and the street railways of that city, especially the Brooklyn City Railway Company, seems to have been transferred from Brooklyn to Albany; for at Mayor Boody's request Senator McCarty has presented a bill imposing a graduated tax upon street railways. The bill provides that in cities of more than 800,000 inhabitants street surface railroads shall pay an annual tax to the city of 1 per cent. when the gross receipts amount to $20,000 a mile; 2 per cent when the gross receipts are from $20,000 to $40,000 a mile; and 3 per cent. when the gross receipts are more than $40,000 a mile. The taxes must be paid into the city treasury on or before the first day of May, and shall be placed to the credit of such fund as the comptroller or other chief fiscal officer of the city shall determine, and the corporation failing to pay such annual percentage shall, after the first day of May, pay in addition thereto 5 per cent. a month on such percentage until paid.

The Ashland (Wis.) Lighting and Street Railway Company started its new power station on Feb. 5. This plant, next to Milwaukee's, is considered the finest in the State. The building is a handsome brown stone structure 140 × 65 feet, with an L 40 × 80 feet. The brick smokestack is 110 feet in height. Four horizontal Pennsylvania tubular 125-h. p. boilers furnish steam to two compound Ideal engines of 175 h. p. each, coupled direct to two 175-h. p. friction clutches. The line shaft, 33 feet in length, carries five clutch pulleys. For the railway department two compound 90-h. p, Ideal engines are each belted direct to two D 62 T.-H. railway generators, which are intended to supply current for six cars equipped with two W. P. 30 General Electric Company's railway motor. The road is a little over five miles in length. The electrical equipment for lighting consists of one A 60 General Electric Company's 1,000-light alternator; one A 6 T.-H. 650-light alternator; two L D 60-light T.-H. arc machines, and one 65 light Brush arc light dynamo, belted to the five clutch pulleys on the line shaft. The entire equipment is furnished by the Northwest Electric Company, of which J. D. Lampson and J. S. Bassett were the representatives in charge.

PERSONALS.

Mr. A. J. Wright, president of the Reliance Gauge Company, Cleveland, O., will attend the St. Louis convention.

Mr. F. A. Scheffler, superintendent of the Brush Electric Company, of Cleveland, O., expects to attend the St. Louis convention.

Prof. E. P. Roberts, of E. P. Roberts & Co., and manager of the Swan Lamp Company, expects to be present at the coming convention of the National Electric Light Association at St. Louis.

MISCELLANEOUS NOTES.

The Electrical Engineers and Mechanics' Association, of Boston, Mass., have sent us a very neat souvenir of their third annual ball, which recently took place there.

McGill University, Toronto, Can., has recently acquired new buildings for the Departments of Engineering and Physics, and we are in receipt of invitations to the opening ceremonies, which will occur Feb. 24, 1893. The buildings will be dedicated by Lord Stanley, Governor General of Canada.

H. T. Paiste, the well known Philadelphia switch manufacturer on Feb. 10 brought suit against the Hart & Hegeman Manufacturing Company, of Hartford, Conn., in the United States Circuit Court in that city for damages and injunction to prevent it from manufacturing and selling certain eccentric movement switches which the plaintiff claims to be infringements on his patent of Oct. 4, 1892, No. 483,862, for his eccentric switch movement.

The Electric Selector and Signal Company, which has succeeded the Electric Secret Service Company, will have at the St. Louis Convention an exhibit of great interest to all electric light engineers. This will consist of the company's system of selective arc light and motor cut-outs. Some recent improvements in the automatic switches will be shown for the first time at St. Louis. The company will be represented there by Messrs. C. P. Mackie, Bobb Mackie, S. S. Bogart and Herbert Laws Webb.

Industrial and Trade Notes.

Mr. William A. Courtland, draughtsman and illustrator, will remove on March 1 to Room 926, tenth floor, Temple Court.

J. Jones & Co., 39 Vesey street, New York City, have issued a convenient catalogue describing the numerous electrical supplies and specialties handled by them.

The Assignment of the W. D. Grave Electrical Manufacturing Company, of Cleveland, O., is only temporary, and business will be resumed in a few days.

The Conover Manufacturing Company, 95 Liberty street, New York City, is reminding its friends of the good qualities of the Conover condensers by a neat calendar.

Huebel & Manger, 286 Graham street, Brooklyn, N. Y., manufacturers of electric bells, etc., state that their plant is pushed to its fullest capacity, and that they are rushed with orders. A ringing bell counts every time.

W. S. Chesley & Co., 24 Morris street, Jersey City, N. J., are buying, selling and repairing all kinds of electric light and power apparatus. They deal in lamp parts, commutators, segments, and everything used in repairing apparatus.

R. T. White's Elevated Railroad is described in a neat pamphlet which Mr. White is sending out and which will undoubtedly prove interesting to those who are connected in any way with electrical railroading and its development.

The Newcastle (Pa.) Steel Company is installing a 200-h. p. Ball engine. The Milton (Pa.) Electric Light Company is putting in a 100-h. p. Ball engine furnished by J. W. Parker & Co., the Philadelphia agents of the Ball Engine Company, of Erie, Pa.

Okonite wire has been specified for the Congress Hotel, the new annex to the Auditorium. Okonite wire was selected purely upon its merits as an insulator, the Auditorium having had a varied experience with other wires and a practical demonstration of the superior merits of the lasting qualities of the Okonite.

The Clark Electric Company, 192 Broadway and 11 John street, New York City, has issued a handsome little catalogue describing apparatus manufactured by this company and paying particular attention to its ornamental arc lamp, which is designed for use upon high or low tension continuous or alternating current circuits, and which is claimed to possess many superior qualities.

The Fibrone-Terraloid Company, of Newark, N. J., will distribute at the St. Louis convention of the National Electric Light Association some very neat little souvenirs in the form of a paperweight made of fibrone. This company manufactures fibrone electrical supplies and specialties of all kinds, and this substance is claimed to possess all the good qualities of hard rubber while at the same time it is considerably less expensive.

The contract to furnish more than a mile of turned steel shafting, ranging from 3 inches to 6 inches diameter, with the necessary hangers, pillow blocks, clutches, etc., for Machinery Hall at the World's Columbian Exposition of 1893, has been awarded to Dodge Manufacturing Company, Mishawaka, Ind. This contract will also include many of their Independence wood split pulleys and several of their American system manilla rope transmissions.

The Turbayne-Tamblyn Company is the successor of the Turbayne Electrical Specialty Company, and has removed from Grand River street to 66-70 East Fort street, Detroit, Mich., where it has secured commodious quarters and will manufacture Turbayne arc lamps, automatic mast arms, cut-outs, and other electrical specialties. The business of this firm has so increased of late that it was absolutely necessary to seek larger quarters.

Universal Electric Manufacturing Company, 741 Cedar avenue, Cleveland, O., has received a letter from W. B. Roberts, general manager of the Rockford Manufacturing Company, Rockford, Ill., expressing great satisfaction with the castings furnished by the Universal Electric Company. The following quotation may be of interest: "We write to say that we note with great pleasure that your castings are improving in quality with each successive shipment."

Chrome Steel Castings.—The Chrome Steel Works, Brooklyn, N. Y., manufacturers of the material known as "chrome steel," which has attained considerable popularity by reason of its peculiar qualities of extreme hardness, strength and durability, find a large demand for their "chrome crucible steel castings," which they are prepared to furnish of any weight ranging from 10 to 2,000 pounds. For gearings, cams, spinning chucks, stamping, drop and hammer dies, these castings have proved very satisfactory and economical.

The Detroit Electric Wiring and Repair Company, Detroit, Mich., has introduced its railway signal system at the Union Depot, and on all roads entering the same for a distance of seven miles out. By this system the switchmen in the different switching towers can tell from the indicator just what train is coming, although it is miles away and not in sight, thus giving plenty of time to throw the different switches and bring the train in on any track that is desired. An annunciator shows plainly when any switch is set wrong, thus avoiding accidents.

Maris & Beekley, 2343-2345 Callowhill street, Philadelphia, Pa., successors to the Maris Machine Company, are meeting with success in the sale of their cranes. During the past few months the following orders have been filled: Bennett, Miles & Co., Philadelphia, Pa.; Edison Electric Illuminating Company, Hazleton, Pa; Henderson Machine Tool Company, Philadelphia, Pa. (five cranes); Menominee Iron Works Company, Menominee, Mich.; Pennsylvania Railroad Company, Altoona, Pa.; Robert Poole & Son Co., Baltimore, Md. (two cranes); Miller Manual Labor School, Crozet, Va.; A. L. Ide & Son, Springfield, Ill.

It is announced that J. A. Fay & Co. and the Egan Company are to consolidate to form a new company known as the J. A. Fay & Egan Company. The directors of the new company will be: T. P. Egan, F. Banner, W. H. Doane, D. L. Lyon, D. Jones, W. P. Anderson, S. P Egan, J. Rawson, and E. Ruthven. T. P. Egan will be president, F. Banner, vice-president, S. P. Egan superintendent, and E. Ruthven secretary. Both these companies are well known, the Egan company having been formed about 1873, while J. A. Fay & Co. was established as early as 1835. The new company will be one of the largest wood-working establishments in the world.

The Ansonia Electric Company (formerly the Electrical Supply Company, of Chicago), has contracted for the Western selling agency of the Helios arc lamp. It is a focusing lamp, and is the only arc lamp that has been constructed to successfully operate on an alternating circuit. It is the same lamp that was officially adopted by the German Government, and although its introduction into this country dates back scarcely ninety days, its reception has been marked with evident approval, as over five thousand have already been sold. With the Stanley transformers, and the Helios arc lamp, the Ansonia Electric Company certainly has a combination to win friends with every central station operating an alternating machine.

The Illinois Electrical Forging Company has just been incorporated with a capital of $2,000,000. Walter G. Campbell, of San Francisco, is president; L. D. Kneeland vice-president, and John P. Skinner, of New York, secretary and treasurer. The offices will be in the Title and Trust Building, 100 Washington street, Room 401, Chicago, Ill. This company will do all kinds of electrical forging, smelting and welding, and will be located at West Pullman, Ill. Mr. Campbell, the president, has been interested for the past few years in mining in the far west and has a wide experience with the various ores. Mr. Kneeland, the vice-president, is also vice-president of the West Pullman Company and a large stockholder.

Mr. T. J. Murphy, 136 Liberty street, New York City, reports that the statements which have reached him in reference to any delay in his turning out and making shipments of slate, etc., are entirely without foundation. All orders coming to him are sent direct to Fair Haven, Vt., where his representative and partner, Mr. Jas. McNamara, immediately places them in whatever quarry the desired size or quality is to be found, and the orders are promptly filled. To illustrate this, a board containing 80 feet was delivered in Brooklyn for the Complete Construction Company 10 Cortlandt street, New York City, five days after receipt of the order. In order to ensure still more prompt delivery Mr. Murphy has erected a steam drill in New York City in order that he can do all the drilling necessary for the mounting of instruments, thus allowing his customers the privilege of examining the board after the holes are drilled before they have been marbleized.

The United States Circuit Court of Appeals for the Sixth Circuit in the case of the Stilwell & Bierce Manufacturing Company *vs.* S. N. Brown & Co., on appeal from the Circuit Court of the United States for the Western Division of the Southern District of Ohio, has reversed the decree and dismissed the appeal. This was a suit brought by the Stilwell & Bierce Manufacturing Company, of Dayton, O., against S. N. Brown & Co. for using a purifier device manufactured by the Hoppes Manufacturing Company, of Springfield, O., for alleged infringement of patent. According to the decree of the court above mentioned, which was rendered on Feb. 8, 1893, the Stilwell patent was not infringed and the Berkshire and Hoppes patent are recognized as distinct inventions.

A New Corporation.—With the assent of 99 per cent. of the stock and bondholders of the Electric Secret Service Company all of the property, patents, business and goodwill of that company were sold by C. P. MacKie, receiver, on Feb. 11, 1893, to the Electric Selector and Signal Company. This new corporation has likewise acquired other important inventions relating to the general subject of electrical selection, and proposes to develop this especial business as applied to telegraphs, block signals, electric light and power and telephones in this country and abroad, on a larger scale than the company which it succeeds. The change has been effected without interruption of the business of the Electric Secret Service Company, and upon terms which provide for a settlement of all that company's obligations in full in cash. The Electric Selector and Signal Company will, we understand, have the same technical management as the Electric Secret Service Company, although its board of directors will contain several new and influential names.

The Purity Oil Filter Manufacturing Company, of Pittsburgh, Pa., reports the largest business in December last of any month in its career, over one dozen oil filters having been shipped. The following are some of the shipments: Portland, Ore., two Ideal steam oil refiners; United States Electric Lighting Company, Baltimore, Md., oil refiner (second order); Union Railway Company, Chester, Pa., one oil refiner; the Pennsylvania Railroad Company, oil refiner, for its dynamo room at Pittsburgh. The Southern Pacific Railroad Company, of California, has bought its third filter since last July. This company has also made many recent sales, including one to the Bridgeport (Conn.) Copper Company, and February bids fair to prove a banner month. Very flattering letters in reference to the Ideal refiners from the Metropolitan Street Railway Company, of Macon, Ga., the Pearson Cordage Company, and others.

The Phillips Insulated Wire Company, of Pawtucket, R. I., will hereafter have its headquarters at 39 and 41 Cortlandt street, New York, which will be occupied by the new president, Mr. H. C. Adams, and his staff. This company will manufacture all kinds of insulated wire, such as triple braided weather proof, damp proof office wire, etc., and has adopted as its trade-mark "O. K." letters standing out in white colors on a black background. Mr. Adams, the president of the company, is quite widely known in electrical circles. For the last few years he has been Eastern manager of the Fort Wayne Electric Company, and prior to that time was connected with the American Electric Manufacturing Company. But Mr. Adams is more widely known as an electric wire man than in any other capacity. In 1867, twenty-five years ago, he first entered the electric wire business, becoming at that time connected with Holmes, Booth & Haydens.

Business Notices.

Transformers removed and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Old Filters for sale cheap. Send for prices to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Johnston's Electrical and Street Railway Directory.—What others say of it:

"We take great pleasure in stating that we think very highly of its contents."—The C. & C. Electric Motor Company, Chicago.

"Your work is creditable to the profession."—Wisconsin Electric Construction Company, Milwaukee.

"It is unquestionably the most complete and comprehensive in its line we have ever seen, and is a credit to its publishers."—Southern Engineering Company, Louisville, Ky.

"We believe you have rendered a substantial service to the electrical interests."—Commercial Electric Company, Indianapolis, Ind.

"I like it very much. It will come often very handy to me."—Chas. Tollner, Pulaski, N. Y.

"We are very much pleased with the directory, and consider it well gotten up."—Gate City Electric Supply and Construction Company, Atlanta, Ga.

"Very nicely gotten up and very complete"—Pedrick & Ayer, Philadelphia.

"It certainly is a beautiful book."—Erie City Iron Works, Erie City, Pa.

"We consider it a great aid to us in our business."—The New Gaynor Electric Company, Louisville, Ky.

"We are much pleased with it. We consider it the best that has come under our notice."—Priestman & Co., Philadelphia.

"Excellent."—H. B. Prindle & Co., Boston, Mass.

"A work that no electrical supply company should be without. The most complete directory we have ever seen."—Dewey Electric Heating Company, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED FEB. 14, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

491,531. Electrical Signaling Apparatus; Jacob B. Currier, Lowell, Mass., Assignor to the Currier Telephone Bell Company, of Mass. Application filed Dec. 15, 1891. The combination of the electromagnet, the armature bar, its electric contact point sustaining the bar, and the electric circuit passing through said contact point, bar and magnet.

491,532. Electric Governor for Signaling Circuits; Jacob B. Currier and David Hall Rice, Lowell, Mass. Application filed Dec. 1, 1892. The combination of the electric circuit, the magnet located therein, its armature, arranged to be drawn toward it by an excess of the electric current, the adjustable contact point, arranged to support the magnet, and the resistance bridge, arranged to shunt a portion of the electric current around said magnet.

491,548. Electric Arc Lamp; Frederick D'A. Goold, Schenectady, N. Y., Assignor to the Edison General Electric Company, of New York, N. Y. Application filed April 15, 1892. The combination, in an arc lamp, with a carbon carrying rod and feed mechanism, of a magnet and armature for operating the same, said armature having an opening in it, and said magnet having a pole projecting into said opening, and a second pole in proximity to the end of the armature.

491,553. Trunk-Line Signaling Apparatus and Circuit for Telephone Exchanges; Edward J. Hall, Morris, N. J., Assignor to the American Telephone and Telegraph Company, of New York. Application filed Oct. 13, 1892. A double conductor telephone or conversation circuit, and two independent signaling circuits extending between two telephone stations; the two con-

ductors of the said telephone circuit constituting respectively the main conductors of the said two signaling circuits.

491,560. Coulomb Counter; George Hummel, Nuremberg, Germany. Application filed Feb. 16, 1891. In a registering meter for electric current the combination of an electric motor the stationary coils of which, forming the field magnet of the said motor, are transversed by the current to be measured having no iron in its magnetic field, and the movable coils of which, in a shunt circuit, form its armature, with a damping device consisting of a disc or cylinder of conducting material driven from the armature shaft, the magnets in the circuit arranged to act upon the damping device, the connection between the damping disc and the armature shaft being positive and non-yielding and the registering device in positive connection with the damping disc.

491,564. Incandescent Lamp Socket; Joseph Hutchinson, New York, Assignor to the Edison General Electric Company, of same place. Application filed June 11, 1891. The combination with the body of a socket, of a sheet metal sleeve on said body and having an end bent at an angle to the body and provided with retaining devices for a shade.

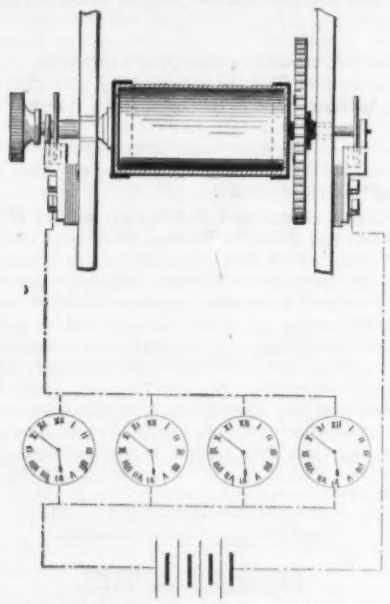
491,567. Conductor for Armatures; Emil Kolben, Schenectady, Assignor to the Edison General Electric Company, of New York. Application filed Feb. 8, 1892. A shaped conductor adapted to form a part of an armature coil, one leg of said conductor being laminated, and the other leg and the section connecting the two legs being solid.

491,568. Armature and Means for Supporting the Same; Emil Kolben, Schenectady, Assignor to the Edison General Electric Company, of New York. Application filed Feb. 8, 1892. The combination of an armature core, flanged rings secured thereto, spider arms extending from the inner periphery of the rings, and an armature conductor or coil surrounding the core and said rings but insulated therefrom, the conductors crossing the inner surface of the armature at the spider arms being at a distance from said surface.

491,580. Escaping Gas Alarm; Charles J. Milligan, Chicago, Ill. Application filed July 23, 1892. In an automatic escaping gas alarm for gas burners the combination of a burner, a chamber containing a conducting fluid provided with a tube containing air and two wires in the chamber and tube respectively, said wires extending to a battery and thence to a sounding or recording instrument, forming an electric circuit which may be broken or connected.

491,595. Telegraph Transmitter; Robert S. Roberts, Philadelphia, Pa. Application filed April 29, 1892. In an automatic transmitter the combination of an angular transmitter having two angle levers, the axle journaled in and supporting the levers and transmitter, and the wheel mounted on the transmitter, the axle and transmitter being electrically insulated from the other parts of the instrument.

491,596. Electric Lamp Fixture or Bracket; James T Robb, Mt. Vernon, Assignor to the Edison General Electric Company, of New York. Application filed Aug. 31, 1891. The combination of a bracket adapted to suppport an electrical device and electrical conductors, a rigidly held base plate for the bracket, having flanges or extensions and carrying terminals formed to engage with stationary terminals on a suitable support, the



No. 491,692.—TIME CIRCUIT CLOSER.

flanges or extensions separate from the terminals and being so arranged that the terminals can be engaged when the bracket base is placed over the stationary terminals in a certain predetermined position only.

491,603. Duplex Electric-Arc Lamp; Charles E. Scribner, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Oct. 27, 1890. The combination with two lamps adapted to burn one after the other and connected in the same circle in multiple arc, of a shunt circuit containing resistance around both lamps passing through two contacts or cut-outs, one controlled by the lever of each lamp whereby when the clutch lever of the lamp which is burning is lowered to close the contact or cut out controlled thereby both lamps will be shunted.

491,604. Electric-Arc Lamp; Charles E. Scribner, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Oct. 30, 1890. The combination with the carbon, rod of an electric arc lamp, of a yielding guide therefor, contact points controlled by said guide to be closed when the weight of the rod comes upon the guide, and a shunt circuit, about the lamp including said contact points.

491,605. Cut-Out for Arc Lamps; Charles E. Scribner, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Dec. 1, 1890. The combination with a shunt circuit around the lamp containing a circuit closer brought into action upon the formation of an abnormal arc to momentarily shunt out the lamp and extinguish the arc of an electro-magnetic cut-out device adapted to close a permanent shunt about said lamp when actuated brought into action by such momentary closing of the shunt circuit.

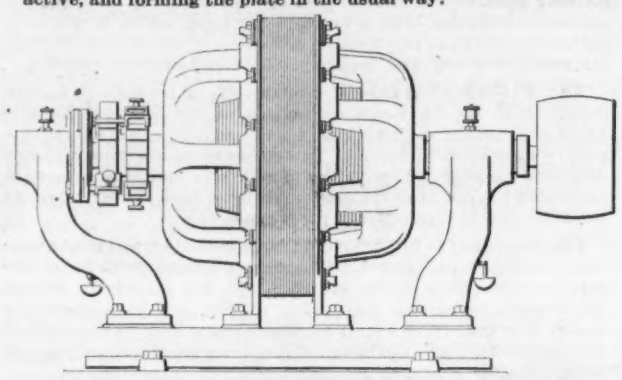
491,609. Track Circuit; Joseph B. Stewart, Haverstraw N. Y. Application filed Nov. 5, 1892. A system of electric railway signals, having the rails of the adjacent sections connected by the usual mechanical connections only, and the rails of each signal section connected by low resistance conductors, in combination with a battery of low power, a relay included in the circuit of said battery, and taps leading from said battery to the lines of rails.

491,666 Electric Locomotive; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed Jan. 16, 1891. The combination with a car axle and wheels, provided with cushioning material intermediate said axle and the tires, of a propelling motor having both armature and field magnets mounted, in part at least, on said car axle, with springs or buffers interposed, the armature being connected directly with said axle.

491,667. Directly Connected Motor for Cars; Sidney H. Short, Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed March 30, 1891 The combination with a car axle and an armature directly connected with the car axle so as to rotate therewith, of a field magnet yoke journaled at its opposite ends on the car axle, said yoke comprising a frame which completely encircles the axle and made in separable sections whereby to facilitate its application to the car axle, and three or more pairs of field magnets placed on opposite sides of car axle with their poles pointing toward the axle said field magnets being secured within and completely encircled and protected by the yoke frame.

491,682. Bushing for Incandescent Lamp Sockets; Cromwell A. B. Halvorson, Saugus, Assignor of one-half to Robert R. Lincoln, of Boston, Mass. Application filed April 4, 1892. In electrical connection plugs or other connections, the combination of a sheet metal plug and an externally smooth cork core or bushing tightly fitting therein and having a perforation for the passage of the connecting wires, said core or bushing having a bulging portion extended beyond said plug whereby contact of the wires with the end of the plug is prevented, and the bushing is held in place.

491,684. Manufacture of Secondary Battery Electrodes; Robert McA. Lloyd, New York, N. Y. The process, substantially as hereinbefore described, of preparing secondary plates or elements, which consists in subjecting a plate to the action of a solution which is acid in the beginning and which afterward becomes alkaline, thereby first producing honeycombs in the surface of the plate, and subsequently chemically depositing thereon active material, or material adapted to become active, and forming the plate in the usual way.



No. 491,695.—ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE.

491,688. Switching System for Telephone Exchanges; Charles E. Scribner, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed May 19, 1892. The combination with two groups of telephone lines, of answering jacks, one for each line located upon one switchboard, line jacks connected with each line of one group and located upon said switchboard, and line jacks connected with each line of the other group, located upon another switchboard, and circuits adapted to connect any answering jack with any line jack of the exchange.

491,691. Series System for Railways; George L. Thomas, Brooklyn, N. Y. Application filed June 16, 1892. The combination with the vehicle carrying an electric conductor and contact pieces insulated from each other and connected with the opposite ends of the conductors carried by the vehicle, of a line wire, swinging arms interposed at intervals in the line wire and forming an essential and permanent part of the line wire circuit, rollers carried in the adjacent ends of the swinging arms, electrically connected contact pieces in position to engage the opposite ends of the swinging arms, and means for automatically swinging the arms in one direction, the said swinging arms being located in position to be swung apart by the passage of the contact pieces carried by the vehicle.

491,692. Time Circuit Closer; Robert H. Twigg, London, England. Application filed Aug. 9, 1892. The combination of a receptacle of insulating material containing mercury, separate metal pivots insulated from each other on said receptacle, and contact pins connected with said pivots for making contact with said mercury and thereby periodically closing an electric circuit through said pivot. (See illustration.)

491,695. Alternating Current Dynamo Electric Machine; James J. Wood, Brooklyn, N. Y. Application filed Oct. 30, 1890. An armature consisting of an annular core of magnetizable metal, two supporting rings fastened against its opposite sides and having conical or flaring flanges projecting from the inner surface of the core, crossing it from side to side, and having their curved end portions bent outwardly and fastened against the flanges of said rings. (See illustration.)

491,708. Electric Motor and Dynamo Mica Insulator; Charles W. Jefferson, Schenectady, N. Y., Assignor to Eugene Munsell & Co., New York and Elizabeth, N. J. Application filed June 1, 1892. A disc for insulating armature heads, consisting of concentric rings of mica scales, radiating from the centre, overlapping and cemented together at their edges.

491,713. Electric Head Lamp; William Main, Brooklyn, N. Y. Application filed Oct 29, 1892. The combination of a lamp case or shell, a lens therein, a lamp, upright or post on said lamp case, a universal joint playing on said upright and supporting the lamp, whereby the light from the lamp may be accurately focused. (See illustration.)

491,726. Accumulator; William A. Macleod, Boston, Mass. Application filed Dec. 17, 1890. An accumulator composed of one or more porous plates which receive and support the active material, and having suitable conducting plates alternating therewith, said porous plates being composed of two parts in contact with one another and having the active material directly applied to their outer surfaces.

491,729. Insulator; Louis McCarthy, Boston, Mass. Application filed Aug. 8, 1892. An insulator comprising a case adapted to contain a connecting piece, an insulating material for insulating said connecting piece from said case, and a cap for said case, said cap having beveled or rounded edges and being secured in place by bending or turning the cap over the edges of said case.

491,758. Electric Signaling Apparatus; Ludwig von Orth, Berlin, Germany. Application filed April 14, 1892. The signal transmitter herein described, consisting of a shaft carrying discs corresponding to the number of the subscribers' offices and to the signal to be sent, a contact arm for each disc, an electromagnet for each arm, an insulated disc provided with a recess and a contact arm, a main contact and a motor.

No. 491,713.—ELECTRIC HEAD LAMP.

491,811. Alternating Current Generator; Octave Patin, Paris, France. Application filed July 8, 1892. In combination, the magnet, the ring armature overhanging the same, the internal teeth on said overhanging portion, and the second series of teeth carried by the armature and projecting outwardly within the magnet, both of said series of teeth being radially arranged.

491,824. Electric Alarm Money Drawer; William J. Walker, St. Louis., Assignor of one-half to Alexander L. Bedford, Savannah, Mo. Application filed Oct. 29, 1892. In a money drawer, a rotatable handle movably secured to the drawer, a spring for restoring the handle to its normal position connected with one end of the circuit, a contact piece at the rear end of said handle carrying a yoke, a contact lug on said yoke, and contact plates co-operating with said lug.

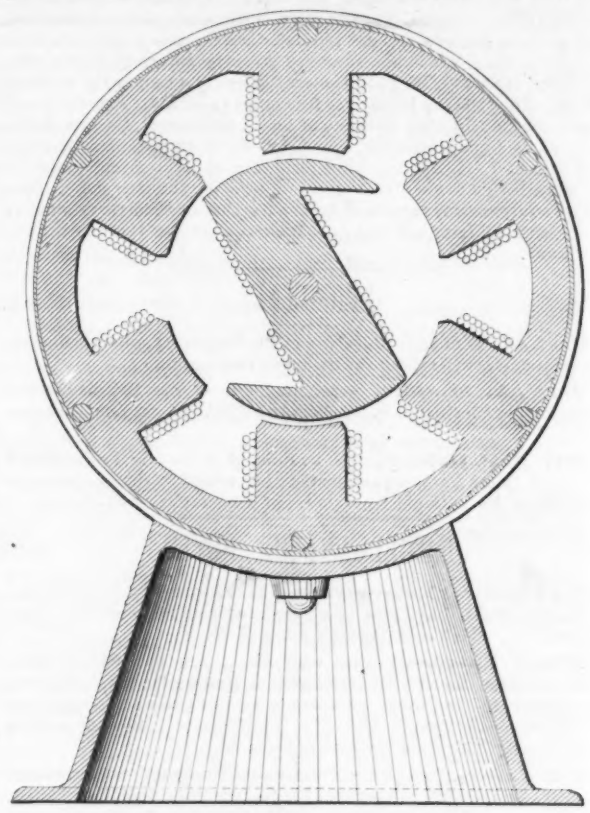
491,829. Electric Motor Regulator; Joseph A. Williams, Canal Dover, O. Application filed Feb. 11, 1892. The combination with the armature shaft, a centrifugal governor having a spindle provided with a pair of friction discs or gears, and the brush carrying arm having a toothed sector of a shaft parallel with the drive shaft and geared to the said sector, a sliding frame in which one end of said shaft is mounted, a transverse shaft mounted in said sliding frame, geared to the shaft carried thereby and provided at its lower end with a friction disc or gear between said parallel discs or gears.

491,837. Railway Train Order and Signaling Device; Leonard T. Crabtree, New London, Wis. Application filed April 2, 1892. A train signaling device, comprising a suspended rotatable cylindric shell, having parallel side walls, circular apertures therein opposite each other, glazed discs on the shell, indicating "danger" by their color and form, and vertical glazed slots in the shell, located opposite each other and indicating "safety" by their color and form.

491,857. Electric Locomotive; Frank B. Rae, Detroit, Mich., Assignor to the Detroit Electrical Works, of same place. Application filed April 11, 1891. In an electric locomotive the combination with a truck frame consisting of metallic side, end and cross-piece united together and provided with metallic angle pieces at the corners to form a rigid structure of blocks of wood secured to the frame, an electromotor, the field magnets of which are provided with flanges, by means of which the motor is attached to said blocks and insulated from the frame, an armature shaft supported in bearings secured to the crossbars of the frame and provided with beveled pinions, and axles mounted on the sidebars of the frame, and each provided with a beveled gear engaging with the beveled pinions of the armature.

491,874. Electric Signal; Frank H. Clarke, Springfield, O., Assignor of one-half to Alfred L. Clarke, of same place. Application filed Oct. 24, 1892. In electric signals for railroads, the combination with a double set of overlapping electric conductors forming blocks, of an auxiliary line of conductors forming a loop extending out into a sidetrack, and means to electrically connect and disconnect such sidetrack loop with the conductors o the main line.

491,878. Secondary Battery; Nathan H. Edgerton, Philadelphia, Pa. Application filed July 11, 1892. A secondary storage battery constructed or arranged and adapted to operate free of any characteristic surrounding electrolytic liquid, consisting of a series of independent non-conducting frames, each frame provided with a metal plate, the respective plates in the end frames of the battery provided on one side with a layer of active material, and the respective intermediate plates provided as to both sides with a layer of active materials, a moisture-absorbing agent



No. 491,970.—ELECTRIC MOTOR.

of the character described, intermediate adjacent layers of active material of neighboring frames, the metal plates in the respective end frames adapted to become of different polarity upon the passing of a charging current, and each intermediate metal plate similarly adapted to become of different polarity as to its respective sides or surfaces upon the passing of a charging current, in successive order throughout the series to preserve polarity, and electrical connections with the end plates only.

491,890. Insulator; Andrew Langstaff Johnson, Richmond, Va. Application filed May 4, 1892. In an insulator the combination with the body thereof, provided with a well for the reception of a non-conducting liquid, of a wire hanger or holder suspended therein, said hanger having three legs, two of which fit in the well, and the third of which is extended and carries the wire at its lower end.

491,893. Telephone Call; John H. Kinsman, Bridgeport, Conn. Application filed Jan. 20, 1892. In an electrical signaling instrument, the combination with a rotatable disc provided with a stop, an electrical circuit provided with a signal and a spring contact, and a polarized relay, the armature of which engages with the stop in the disc and with the spring contact.

491,915. Electric Arc Lamp; William Hopkin Akester, London, England. Application filed Sept. 9, 1892. In an electric arc lamp, a regulating device consisting of a shaft, a wheel mounted loosely thereon, a spring or the like for normally retaining the shaft in a given position, a screw thread upon the shaft, a nut loosely engaging the screw thread and adapted to engage the wheel, means for causing the carbons to rise and fall by the rotation of the wheel, a solenoid, and suitable connections from the core of the solenoid to the nut for causing the same to partially revolve with the rise or fall thereof.

491,916. Electric Arc Lamp; William Hopkin Akester, London, England. Application filed Sept. 9, 1892. In an electric arc lamp, a regulating device consisting of a vertically movable box or case filled with spherical pellets and held in its normal position by a spring or weight, a rod passing therethrough and connected with one of the carbons, an apertured disc located within the box, and a stud or projection bearing upon the disc and carried by some electrically controlled part of the lamp.

491,945. Self-Winding Electric Clock; Emil Klahn, of West Hoboken, N. J., Assignor to Daniel C. Hood, New York, N. Y. Application filed Feb. 17, 1892. In a self-winding clock the combination with a clock mechanism of a winding roller connected therewith, the driving weight and cord, a counterbalancing weight and cord, a shaft upon which said cords wind in opposite directions, an electric motor for revolving said shaft, and a vibrating lever carrying a contact arm adapted to make and break the current, to revolve or stop the shaft.

491,970. Electric Motor; Alexander W. Meston, St. Louis, Mo. Application filed June 15, 1891. In an electric motor, the combination with a field magnet provided with a plurality of polar extensions, and helices on said polar extensions, of an armature, a stationary distribution plate or plates, and a revolvable contact making device interposed between the contact plate and distribution plate. (See illustration.)

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co. Ltd. Times Building, N. Y.